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THE TELEGRAPHIC JOURNAL AND
Electrical Review.
VOL. XVI.—NO. 373.

THE APPLICATIONS OF ELECTRICITY TO RAILWAY SIGNALLING.

THERE are few, if any, applications of electricity which are of greater importance to the public than its applications to railway signalling. Without the help of electricity it would be utterly impossible to carry on the heavy suburban traffic for which the English railways are so remarkable, nor, indeed, would it be possible to conduct the ordinary main line circulation of trains with a chance of safety unless some electric block system were in operation. In the electrical engineering world there is no very great scope for work of this description and least of all to amateurs, as an intimate knowledge of railway working is almost absolutely essential in order that any decided improvement may be effected. It cannot be claimed that any existing electrical block system is perfect, but perfection is being approximated to, and there is little more to be done in the direction of plain signalling, *i.e.*, in the system of transmitting and checking the directions by which the outdoor signals are set. The working of the latter by electricity instead of by direct mechanical means, has recently been taken in hand by Messrs. Timmis and Currie, and, we believe, with success, though it is too early to pronounce upon the lasting merits of their system. A few years ago one of the Highland railways was worked by an automatic system of outdoor signals actuated by electricity; whether the experiment proved to be a permanent success we are unable to say, but it was at least demonstrated that such automatic working was possible. A short time ago Mr. C. E. Spagnoletti invented and used an electric signal, which was tried on the Metropolitan Railway as an experiment; the semaphore arm at one station, in this case, was worked from the distant station, the movement of the arm being effected by a very strong local battery called in action by a relay. This signal, we believe, worked correctly, and the fact that it has not come into general use seems to indicate that no decided advantage would arise from its employment. In fact, we think that the absence of a demand for apparatus of the kind has more to do with its non-employment than anything else. The recent accident caused by the junction points failing to work in correspondence with their lever owing to a disconnection in the connecting rod is, we believe, a case almost unheard of; the necessity for indicating their actual position by means of electrical repeaters has therefore not occurred, though the possibility of employing such devices is, it is perhaps needless to say, perfectly well known to all railway telegraph engineers. Possibly, as a consequence of the accident referred to, the use of such repeaters may become frequent.

It has often been stated as an axiom, that in railway signalling the absence of a signal to indicate line clear should be taken as an indication that the line is blocked. The want of attention to this, if accounts are to be believed, has, nearly, in the case of the London and Manchester express accident at East Retford, led to serious consequences. It appears that in the absence of a bell signal to the effect that a train was expected, the level crossing porter opened the gates, with the result that the express in question dashed into them. The custom was for the distant signalman to sound the bell at the crossing when the train was expected; the bell was, it appears, rung, in so far that the signal plunger was pressed, but as the bell was itself out of order, no signal was given. Had it been laid down as it ought to have been, that the attendant at the level crossing should in the first case ask by code, or otherwise, whether the line was clear or not, and then on the receipt of the all clear signal, *and only then*, open the gates, the accident would not have happened.

With a prosperous condition of things we might safely predict increased applications of electricity to railway signalling, but with falling dividends consequent on commercial depression, any such improvements entailing, as they must, extra expenditure, will be very tardily effected.

ON A DIFFUSION PHOTOMETER.

By M. A. CROVA.

THE necessity of comparing powerful sources of light, such as that of arc lamps and of the sun with a relatively feeble standard, is one of the difficulties of photometry. The measurement of the intensity of powerful foci must therefore be obtained by the use of methods for reducing the intensity of the source under examination in a proportion variable at will, but accurately known.

The method which I employ is based upon the following principle: let there be a plate of ground glass, of milk-glass, or a Foucault screen—in a word, any diffuser—place it in a uniform luminous field, normally to the incident rays; each point of the diffuser may be considered as a luminous source which emits behind the screen a light, the intensity of which depends on the nature of the diffusing screen and varies with the angle of emersion according to a law which depends on the nature of the diffuser; but whatever that law, the rays diffused in directions very near the normal have an equal intensity.

We fix behind the diffuser an opaque screen, provided with a slit of a width variable at will; the intensity of the light emitted normally by this aperture is proportional to that of the luminous field in which the diffuser is placed with a coefficient of reduction, k, which depends on the nature of the diffuser, on the surface, s, of the aperture and varies inversely as the square of the distance.

Let i be the intensity of the light emitted by the surface, s, of the diffuser, and x that of the field in which it is placed, we have then:

$$i = k\,x\,s.$$

whence

$$x = \frac{i}{k\,s}.$$

i is given by the diffusion photometer and s by the graduation of the slit; k is obtained previously if we receive the light determining the field in which the photometer is placed upon a Foucault's photometer fixed at a sufficient distance.

By this method we may measure very easily the intensity of the solar light and that of arc lamps. The determinations which I have made with the sunlight equal about 7,500 carcels, and a Serrin lamp which I caused to vary from 230 to 320 carcels, have proved that the method is applicable to all possible cases; we may measure with the same ease and the same precision the intensities of lamps of 1,000 to 4,000 carcels.

The diffusion photometer which I use is composed of a head of Foucault's photometer upon the starched screen of which fall the two lights to be compared in two rectangular directions, each forming with the normal an angle of 45°. The one light is that of the standard carcel, placed exactly at the distance of one metre, in a blackened box fitted with a wide tube blackened with smoke internally, and which throws the light upon the screen. The other is that of the lamp, &c., under examination; it passes through a second tube fixed to the photometric head, movable on a graduated circle, fixed perpendicularly to the axis of the former tube.

The board upon which is fixed the photometer, fitted with its lamp, can revolve on a vertical axle passing through its centre on a foot which supports the whole apparatus. The movable tube may thus be turned in height or in azimuth and directed to the source of light which is being studied, whatever may be its position.

One of the halves of the photometric screen receiving the constant illumination of a carcel is sufficient to reduce the light which arrives on the other half so as to render it equal to the former. This result is obtained easily by closing the extremity of the movable tube with a lid fitted with a rectangular slit, of 0·01 metre in length and of a variable length determined by means of a micrometer screw. The diffuser covers the variable slit, and that portion of its surface intercepted by its aperture constitutes the source of light.

Let d be the distance of the luminous source from the diffuser, l the length of the movable tube; the luminous field in which is the diffuser is $\frac{x}{d^2}$; the light received upon the photometric screen will be

$$\frac{x}{d^2} \cdot \frac{k\,s}{l^2}.$$

But this intensity = C, if we call C the value of the carcel deduced from the time required for burning 10 grms. of oil. We have:

$$x = \mathrm{C}\,\frac{l^2\,d^2}{k\,s}.$$

In my photometer, $l = 0{\cdot}50$ metre, and d is constant and equal to 1 metre. We have, therefore,

$$x = \frac{\mathrm{C}}{4\,k\,s};$$

if we put $\frac{1}{4\,k} = n$, we have

$$x = \mathrm{C}\,\frac{n}{s}.$$

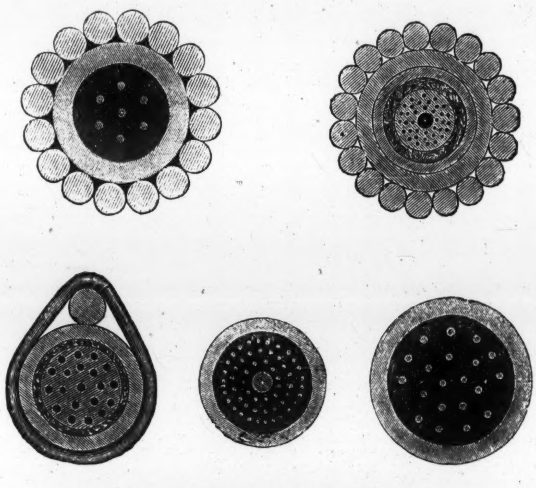
n represents the intensity in carcels of the field in which we must place the diffuser so that 1 square centimetre of its surface emits a light, the intensity of which equals 1 carcel. This constant, determined previously, characterises the diffuser; thus a dulled glass of 400 carcels is a glass of which 1 square centimetre, placed in a field of 400 carcels, emits the light of 1 carcel.

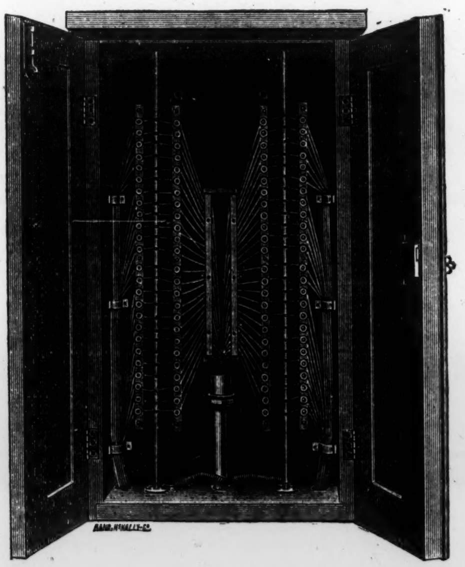
I have made use of dulled, or ground glasses of 200 to 400 carcels for arc lights, and milk glasses of about 4,000 carcels for the sun. Under these conditions the photometric intensity is determined rapidly, and almost without calculation, even for the most powerful burners, as for an assay of gas in a dark chamber of a few square metres, or even in the daylight with the aid of certain arrangements. The Foucault screen is viewed through the solution 580, as I said in my former communication.

Lastly the movable tube of the photometer being capable of turning in all directions, and the angle of its axis with the horizon being known by means of the graduated circle, we may, by moving the lamp vertically, determine its spherical mean.—*Comptes Rendus.*

PATTERSON'S PATENT CABLE.

PATTERSON'S Patent Cable is a group of conductors each covered with two or more windings of cotton or jute saturated with paraffin and protected by a lead pipe. The space between the group of conductors and the lead pipe is filled with paraffin specially treated. The conductors may be made in continuous lengths of 1,500 feet, the protecting pipe being jointed over them in shorter lengths. Should any flaw exist in the lead pipe it is detected by the process of filling. This process completely overcomes, it is said, the difficulty to which we referred in our issue of January 10th, as it renders the paraffin filling elastic. The formation of cracks is thus prevented, so that even in the event of injury to, or breakage of the lead pipe, the conductors would remain perfectly insulated and free from moisture. Another and not less important feature of the process is to reduce the specific inductive capacity of the insulating material at least 15 per cent. For this reason a smaller conductor may be used, and any trouble from "induction" or "cross-talk" due to the static charge or condenser action of the wires is to a great extent prevented by the diminished surface. All cables of





No. 26 or No. 22 gauge conductors, except those in which the wires are twisted in pairs, contain a large central conductor as a preventive against induction. Terminal boxes are provided, enabling the conductors to be readily connected with other wires leading to the cable. The lead pipe is armoured when necessary according to the requirement of the occasion. The Patterson Patent Cable is manufactured by the Western Electric Company, and is very largely used for telephone purposes. Our illustrations represent sections of cables with plain lead pipe, armoured, and suspended, as well as one form of terminal box.

ELECTRICAL COMMUNICATION BETWEEN VESSELS AT SEA.*

A FEW years ago, I made a communication on the use of the telephone in tracing equipotential lines and surfaces. I will briefly give the chief points of the experiment which was based on experiments made by Prof. Adams, of King's College, London. Prof. Adams used a galvanometer instead of a telephone.

In a vessel of water I placed a sheet of paper. At two points on that paper were fastened two ordinary sewing needles which were also connected with an interrupter that interrupted the circuit about 100 times a second. Then I had two needles connected with a telephone; one needle I fastened on the paper in the water, and the moment I placed the other needle in the water I heard a musical sound from the telephone. By moving this needle around in the water, I would strike a place where there would be no sound heard. This would be where the electric tension was the same as in the needle; and by experimenting in the water you could trace out with perfect ease an equipotential line around one of the poles in the water.

It struck me afterwards that this method, which is true on the small, is also true on the large scale, and that it might afford a solution of a method of communicating electrical signals between vessels at sea.

I made some preliminary experiments in England and succeeded in sending signals across the river Thames in this way. On one side were two metal plates placed at a distance from each other, and on the other two terminals, connected with the telephone. A current was established in the telephone each time a current was established through the galvanic circuit on the opposite side, and if that current was rapidly interrupted you would get a musical tone.

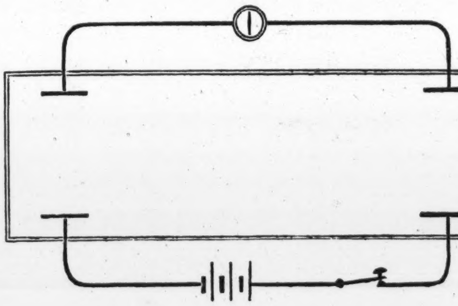
A few years ago, I found that our distinguished President, Prof. Trowbridge, had very similar ideas in connection with the possibility of communicating between vessels in a fog. Using a dynamo machine for charging the water, a distant vessel might receive signals when getting in dangerous proximity to the other.

Urged by Prof. Trowbridge, I made some experiments which are of very great value and suggestiveness. The first was made on the Potomac River.

I had two boats. In one boat we had a Leclanché battery of six elements and an interrupter for interrupting the current very rapidly. Over the bow of the boat we made water connection by a metallic plate, and behind the boat we trailed an insulated wire, with a float at the end carrying a metallic plate, so as to bring these two terminals about 100 feet apart. I then took another boat and sailed off. In this boat we had the same arrangement, but with a telephone in the circuit. In the first boat, which was moored, I kept a man making signals; and when my boat was near his I would hear those signals very well—a musical tone, something of this kind, tum, tum, tum. I then rowed my boat down the river, and at a distance of a mile and a quarter, which was the furthest distance I tried, I could still distinguish those signals.

It is therefore perfectly practicable for steam vessels with dynamo machines—and most large steam vessels use the electric light, which requires a large dynamo machine—to know of each other's presence in a fog when they come, say, within a couple of miles of one another, or, perhaps, at a still greater distance. I tried the experiment a short time ago in salt water of about 20 fathoms in depth. I used then two sailing boats, and did not get so great a distance as on the Potomac. The distance, which we estimated by the eye, seemed to be about half a mile; but on the Potomac we took the distance accurately on the shore.

Prof. **TROWBRIDGE**: I am very glad you have all heard Prof. Bell's exposition of a subject of this nature in which I think he excels all of us in America. He has referred to me in this connection, but I can only say that some years ago I published an account of a plausible method of sending signals across the Atlantic Ocean without any cable. I do not mean you to infer that it is at all practicable, but it is possible. If you will allow me for a moment, suppose this represents the two continents (making an outline of the continents). If you should have a dynamo machine in Philadelphia and ground one terminal in Patagonia and the other in Labrador, then a telephonic circuit through here (indicating) would enable you to hear signals that are made on the first circuit. It is perfectly possible. In fact, I have tried the same experiment which Prof. Bell refers to in Cambridge, at a lake called Fresh Pond. I then heard signals sent from Boston to Waltham, a distance of 10 or 12 miles, by simply having the terminals of the telephone—that wonderful instrument invented by Prof. Bell—in Fresh Pond, where they must have been a long distance away from the earth of battery.



In regard to the fog signals at sea, my effort has been in a somewhat different direction. My effort has been to ascertain with galvanometers the direction of vessels which are approaching. The arrangement is like Prof. Bell's. Each vessel carries a dynamo machine, grounds one terminal of the circuit at the bow, and trails a wire, uninsulated, at the end only, over the stern. Each vessel is provided with a cross-arm and a galvanometer in the circuit, of which the terminals enter the water at the ends of the cross-arm. When one vessel comes within the field of the other the galvanometer will show how the equipotential lines are disturbed, and if you had a careful map of those equipotential lines you could ascertain where the other vessel was. The method could also be applied to saturating water in the neighbourhood of a rock, and you could take electrical soundings, so to speak, and ascertain your place from electrical maps carefully made out.

Mr. W. H. **PREECE**: If you will allow me the use of the board I think I can give the section details of a real and practical experiment, which combines both the ideas of Prof. Bell and Prof. Trowbridge. In the South of England we have a charming island called the Isle of Wight. This is separated from the mainland of Hampshire by a channel of a mile and a quarter at one end and about six miles at the other. Portsmouth comes here (indicating) and is distant across about six miles. Then comes the narrow channel, called Hurst Castle, and Southampton is here (indicating). Newport, in the centre of the Isle of Wight, is there (indicating).

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* An abstract of a paper read by Mr. A. Graham Bell, with discussion thereon, American Association for the Advancement of Science, 1884.

The Isle of Wight is a very busy place. There are several important towns ; the Queen's marine residence is there, and the cable across at Hurst Castle is of consequence. For some cause the cable broke down, and it became of great importance to know whether we could communicate across, so I thought it a timely opportunity to test the ideas that had been promulgated by Prof. Trowbridge. I put a large plate of copper about 6 feet square in the sea at the end of the pier. A wire passed from there to Newport and from Newport to Hurst Castle, and in the sea there I placed another copper plate. Opposite at Hurst Castle was a similar plate, and the wire passed from there overground to Southampton, from Southampton down to Portsmouth, and then into the sea again at Southsea Pier. We have here a complete circuit if we take into consideration the water, the circuit starting from Southampton to Portsmouth through the sea, six miles to Newport, to Hurst Castle, thence across Hurst Castle, a mile and a quarter, and thence to Southampton again.

We connected the telephones in the circuit, but we could not converse by them. But when we placed at Southampton and Newport what are called "buzzers"—they are little instruments that make and break the current with great rapidity, and make a buzzing sound, and for every vibration send a current into the circuit—with these buzzers and about 25 cells of Leclanché it was quite possible to communicate between Newport and Southampton, although the circuit was broken by six miles of sea at one end and one mile and a quarter at the other. If it had not been that the cable was repaired the very next day communication would have been continued between the mainland and the Isle of Wight in this manner. And when the cable breaks down again telegraphic communication will be conducted across the Solent, a distance of six miles and a mile and a quarter, by the same means I have described to you to-day.

Prof. VALENTINER (of Germany) : Several years ago I made a lecture room experiment, which may be of benefit to professors. Take an elongated trough, and place on one side a battery with a key ; then here a plate, another plate on the other side, with a galvanometer in the circuit to detect the current, here a plate with another on the opposite side, finally returning to the battery with the key. If the trough be filled with water any movement of the key here will cause a deviation of the needle of the galvanometer. It does not need a very strong battery to do that. I tried that experiment on one of the canals in Holland on a large scale, but I found that the results were very doubtful. I see now that the current was too weak.

UNDERGROUND TELEGRAPH WIRES.*

REPORT OF SIR WILLIAM THOMSON UPON THE RESULTS OF RECENT EXPERIMENTS.

THE results of Sir William Thomson's recent experiments on the employment of underground wires for telegraph lines are given in the following report to Mr. Mackay :—

No. 18, Fitzroy Street, London, W.

J. W. MACKAY, ESQ.,

Dear Sir,—In the report which we now have the honour to submit on the employment of underground wires for telegraphic communication, we have made no attempt to treat the subject exhaustively. We believe that your object was to obtain our opinion on two broad questions—whether a telegraphic system could be worked rapidly and efficiently through underground lines, and whether these lines would be durable. Messrs. Siemens recommend an underground cable similar to that which is used by the German Government.

This cable contains seven copper strands, each weighing 90 lbs. per mile, and insulated with gutta percha weighing 76 lbs. per mile. The seven insulated wires are contained in a sheath of 24 galvanised iron wires, each 0·102 inch diameter. The weight of the iron is about 4,080 lbs. per mile. These iron wires are further protected by jute and compound. The weight of the whole cable is about 6,100 lbs. per mile. Its breaking strength is four and a-half tons. This type of cable is well suited for the purpose to which it is applied.

Experience has shown that cables of this description buried in the ground without further protection are extremely durable, and are exposed to very few accidental injuries. We are unable to fix a term to the life of these cables, because up to the present time no similar cable has, we believe, required renewal or shown any sign of serious injury. These remarks apply both to the iron sheathing and the gutta percha core. No insects have, as far as we know, attacked the gutta percha in these or similar cables, either in this country or in any other. The experience in temperate climates has been large, and some very considerable lengths have been employed by the German Government to form a network of lines for military purposes. In hot countries some experience has been derived from short lengths of cable used in trenches on land to connect submarine lines with land stations. In some cases extreme heat has injured these short connecting lines, but we believe that this has occurred only where proper trenches could not be dug for their protection. We are, therefore, of opinion that, as regards durability and freedom from accidental interruption, underground cables would give very satisfactory results.

The transmission of messages through underground wires is subject to two actions which tend to limit the number of signals which can pass from station to station in a given time. The name induction is commonly applied to both these actions, which may be distinguished one from the other, as static induction between the copper conductors and the earth, and magnetic induction between adjacent insulated wires. We believe that in all cases likely to arise in practice magnetic induction may be neglected, and, moreover, its effects can in some degree be neutralised by judicious arrangements. The effects of static induction cannot be eliminated by any known contrivance. The well-known limitation of speed through submarine cables is due to static induction, and a similar action takes place in all underground wires. Formulæ derived from submarine lines enable us to calculate with considerable accuracy what traffic can be passed through long underground lines of a given type when these are worked with the same expensive instruments as are employed for submarine lines. Thus, with the type of cable described above, we reckon that by using the siphon recorder or mirror instruments, a good clerk would work at his full speed, sending from 20 to 30 words per minute through any length not exceeding 1,000 miles. A high class of clerk would, however, require to be employed, and it is possible that magnetic induction from wire to wire would, in these great lengths, be inconvenient. We do not believe that transmission by underground lines in this manner would be likely to compete on favourable terms with transmission by overhead wires. It has, therefore, been our duty to satisfy ourselves as to the traffic which could be carried on by ordinary apparatus through the underground lines. The officials of the English Post Office informed us that they were without knowledge on the subject, but Mr. Preece, the engineer-in-chief, was, however, so obliging as to offer us for experiment the use of some new underground wires now being laid near London, and we made a series of experiments, with the following results, using a good Morse recorder and a Wheatstone automatic sender :—

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* New York *Electrical Review*.

Length of Line. Miles.		Words per Minute.
27	more than	220
88	„	130
116	„	100
181	„	35

On the length of 181 miles a similar experiment was tried with hand sending and a Morse sounder, as the receiving instrument worked by a relay; 30 words per minute were sent, and probably the full speed of 35 words could have been reached by a good clerk. The general conclusion is that for short lengths, such as 30 miles, extremely rapid sending by automatic instruments might be employed, and duplexing, or even quadruplexing might be employed. On lines of 100 miles automatic instruments could still be employed with advantage, but the effects of static induction would be quite sensible, and would render any speed greater than 130 words per minute difficult of attainment. The ordinary hand signalling was to be practised with no sensible impediment on all lines under 200 miles in length, and at this distance relays could be worked, retransmitting the messages automatically, so as to connect places distant from each other by at least 500 miles. There is no doubt whatever that any amount of traffic could be worked through a system of underground wires at the usual rates of hand sending.

The expense of establishing underground cables must always be greatly in excess of the cost of aerial lines capable of transmitting the same amount of traffic. But in cost of maintenance, we believe that an underground system would compare very favourably with aerial lines. Underground wires will also be almost wholly free from interruptions due to storms or to extremes of heat and cold, whereas aerial lines, however well constructed, must always be subject to injury from wind, snow, and extreme cold.

We have heard it suggested that lines composed partly of underground wires and partly of suspended wires would be more difficult to work than lines constructed wholly on the one or the other system. This is an error. It is, however, perfectly in accordance with the theory that the addition of any considerable length of aerial wire to a long underground circuit will materially reduce the speed of working. The reduction in the speed will, however, be less than if the length of line added were also composed of underground wires. Thus, in the experiments already spoken of, an addition of 50 miles of aerial line to the 181 miles of underground line reduced the speed from 35 to 28 words per minute. But if an additional length of 50 miles of underground wire had been added, the speed would have fallen to 15 words.—Very sincerely yours,

THOMSON AND JENKIN.

COST OF LIGHTING THE NEW STRASBURG STATION.

THE installation of the electric lighting at the Strasburg railway station, exclusive of the apparatus used for the offices of the administration, has cost 305,950 francs—204,040 francs for arc lights and 101,910 for incandescence lamps.

From January 1st to March 31st, 1884, a period during which the lighting has been kept up in a regular manner, the number of hours of action for the arc lights (A) has reached 59,755; that of the 16 normal candle glow lamps (B) 142,194, and that of the 10 candle glow lamps (C) 211,924.

The costs of working, not including interest and paying off first outlay, have been:

For lamps A	11,060 francs.
„ „ B	2,410 „
„ „ C	2,500 „
Total	15,970 „

which brings the hourly cost price of lighting, maintaining buildings, machines, lamps, conductors, &c., to:

For lamps A	0·185 francs.
„ „ B	0·017 „
„ „ C	0·012 „

If we take into account the interest and the paying off the first cost at the rate of 4 per cent. for the first item and 3 per cent. for the latter, the charges for maintenance amount to:

Lamps A	17,180 francs.
„ B	3,730 „
„ C	4,240 „
Total	25,150 „

bringing the hourly cost to:

Lamps A	0·290 francs.
„ B	0·026 „
„ C	0·020 „

Since the opening of the new station the glow lamps have burnt each, on an average, for 1,328 hours.

We see, therefore, that the hopes entertained concerning this mode of lighting have been largely realised. To show the economic phase of the question it will be sufficient to compare these expenses with those which would have been occasioned by lighting with gas.

To this end we will assume as the basis of our calculations that to light up the entrance square, the peristyles and the platforms there would be required 44 groups of 20 burners; for the interior halls 16 groups of 12 burners, and in place of the 404 glow lamps 404 burners; each burner consuming 0·15 cubic metres per hour. It follows that this lighting would require (44 × 20 + 16 × 12 + 404 × 1) = 1476 burners—880 for the outside portions of the station and 596 for the interior. It has been calculated that the cost price of a gas-burner, including the gas piping, candelabra, &c., would be for the exterior service 244 francs, and for the interior 50 francs. The cost of the installation for gas lighting would therefore be:

$$(880 \times 244 + 596 \times 50) = 244{,}520 \text{ francs.}$$

The 60 arc lights together have burnt during 59,155 hours, or each on the average for 996 hours. Consequently the 1,072 corresponding gas-burners (44 × 20 + 16 × 12) would have burnt ... 1,067,712 hours.

The 404 glow lamps and consequently the 404 gas burners would have burnt ... ... 354,118 „

1,421,830 „

For an hourly consumption of 150 litres and a price of gas of 0·20 franc per cubic metre, the cost of gas lighting would be:

1,421,830 × 0·15 × 0·20... ... 42,654.90 francs.

Add the price of maintenance at 3.75 francs per burner yearly, for three months, *i.e.*,

$$\frac{880 + 596}{4} \times 375 \quad \dots \quad 1{,}383.75 \text{ „}$$

Total for three months ... 44,488.65 „

If we calculate equally 4 per cent. for interest and 8 per cent. for redemption on the first cost, we have for three months:

$$\frac{244{,}528 \times 12}{4 \times 100} = 7{,}335.60 \text{ francs.}$$

The total cost of lighting with gas, including the cost of interest and redemption is:

$$44{,}488.65 + 7{,}335.60 = 51{,}824.25 \text{ francs.}$$

These calculations enable us to contrast the following figures:

	Electricity.	Gas.
First cost	305,950	244,520
Working cost and maintenance for three months	15,970	44,488.65
Do., including interest and redemption	25,150	51,824.25

—*L'Electricien.*

[It will be remarked that the price of gas quoted, 0.2 franc per cubic metre, is equal in round numbers to 4s. 9d. per 1,000 cubic feet.]

TRAIN LIGHTING BY ELECTRICITY.

WE reproduce under, as of interest to our readers, several letters which have appeared in *Engineering* upon the subject of the illumination of railway carriages by electricity, regarding which previous correspondence has appeared, taken from the same source, in our columns. Mr. W. Langdon writes:—"The question of space occupied by the electric light machinery; the advantage and disadvantage of accumulators; the necessity or rather non-necessity for lighting railway carriages when in a railway station, and the weight to be carried has been discussed. No doubt the whole of these questions are questions of importance, but I cannot help thinking the first question to be determined with respect to this form of illumination for railway trains is the maintenance of the light at all times. So far the experiments which have been made have been confined to trains which run intact—which are not broken up—and which are drawn by one and the same engine throughout the journey. There is thus no break of continuity between the engine, tender or van which carries the generator of the electrical current, and so long as the locomotive is attached to the train sufficiently in advance of the time of its departure, to enable the passengers to take their seats, no inconvenience should arise. For short journey trains or for trains which run intact throughout the journey, the electric light will probably be found serviceable, and certainly, as against the oil lamp, economical, whilst in point of brilliancy its advantages over oil are enormous. The main point, however, to which I am desirous of directing attention, is the necessity of assuring at the least a reasonable light for carriages when detached from their source of light. This source of light has so far been concentrated at one point in the train—when that point is disconnected the light is withdrawn, and the rest of the train is left to darkness or such light as it may borrow from surrounding objects. Now it must be clear to every unbiassed mind that neither would passengers submit to be left in a carriage unlit, nor would railway companies wish their passengers to be so left. It is equally clear that when we come to deal with the generality of railway trains, there will arise throughout each journey occasions when the locomotive has to be changed, and probably certain portions of the train disconnected. It is to the lighting of these disconnected portions of the train I would beg to direct the attention of those interested in the subject. Until a means of accomplishing this is devised, it is improbable electric lighting in railway trains will obtain a sound hold. It has always appeared to me a *sine quâ non* that each vehicle should carry its own means of illumination, whether that means of illumination is electricity or gas."

Mr. H. Justus Eck thinks the question ought not to be that of one system of electric lighting against another, but that of electric light *versus* gaslight, when the advantages and economies of the former when used for this work will stand forth very prominently. First amongst these will come that of first cost of the plant which, he believes, is nearly one-third of that of the gas fittings and holders on the vehicles themselves, to say nothing of the cost of plant for making the gas. Then again there is the cost of maintaining a staff to make the gas as well as to light and clean the lamps, and to recharge the gasholders on the arrival of the train at the terminal platform, which staff is now entirely dispensed with, it being only necessary to change the burnt-out lamps, which the guards can easily do. After taking these things into consideration he cannot see how the Great Eastern Railway can be paying a high price for their light even without considering the superior illumination they are now getting. Mr. P. W. Willans having said, "Few engineers will be found ready to take as a basis for the comparative cost of the two systems the increased coal consumption in a large locomotive boiler when a 5 horse-power engine is at work driving the lights," Mr. Eck thinks this is exactly what the railway authorities will do, as this is the point from whence the cost of the lighting can be arrived at, as the other expenses, viz., those of oil, renewal of lamps, depreciation of engine and dynamo, and wages of a man to see that the dynamos are in proper order, and that the lamps and wires are not broken (one man being amply sufficient for six trains), all of which, besides being easily calculable, are well known. He hardly agrees with Mr. Gisbert Kapp's ingenious idea of adopting "flexibles" *versus* accumulators, as those acquainted with the driving of locomotives know that the engine drivers only run forward and leave the train for water when in actual need of it, which may happen at any station, and it would thus be necessary to have dynamos, &c., running at several stations on the line; further, the great advantage of the present system is that all the lighting is self-contained, and only needs one set of accumulators to make the carriages independent of the engines whilst they are taking water or being changed.

In reference to the statement by Mr. Massey that their system in use on the Great Eastern Railway "is dearer in the first instance, and costs more to maintain it," Messrs. Heenan and Froude write:—"Does he mean that the engine is costly, or the dynamo costly; or that the engine wears out soon, or takes a great deal of steam, or that the dynamo is inefficient? Has he had any experience with engine or dynamo, or both together, that warrant him in saying the above? We do not deny that saving of fuel is a desideratum; but when Mr. Massey implies, seemingly unconditionally, that saving fuel is more important than saving space, in contradiction to Mr. Crompton, who commends our arrangement as a whole because of the space saved, we come to an issue with Mr. Massey, and distinctly say that it *may* be worth while to sacrifice *some* economy of fuel in order to economise space, notably on a locomotive, where, although the locomotive is a big thing, available places for placing engine and dynamo are not unlimited."

Mr. Robert Woodley says:—"All the assertions Mr. Massey may make regarding the 'false economy' of the Great Eastern Railway system ef electric train lighting, and his concluding prophetic remarks as to high price of light, &c., will not, I am sure, convince 'our railway friends' unless he bases his opinions on hard facts. Had Mr. Massey first informed himself of the first cost and maintenance of the Great Eastern Railway system, and then compared notes with the results of his own experience, he would no doubt have been able to give 'our railway friends' in particular, and the public in general, some really useful information on the subject; as it is, however, his remarks savour so much of interested motives that readers will no doubt recognise in the letter which follows the source of 'all his woes.' This letter by Mr. Willans, after objecting to 'compressed machinery,' complains that Mr. Crompton did not experiment with a separate boiler in a brake-van as did Mr. Massey, so as to get 'an idea of the actual cost of train lighting.' This naturally infers that Mr. Crompton could not find the steam consumption of a motor driving a given number of lights at his works, but must cart about a dynamo twice as big as he required, a boat boiler, and young marine engine, eminently unsuited to the purpose. I ask is this the way to ascertain the practical utility and efficiency of such a system of train lighting, and may we not justly reason that the author of such an experiment has to thank himself only for 'scotching' this promising industry? In conclusion I would point out that a train of 15 coaches and two vans lit on the Great Eastern Railway system has been in regular running for nearly three months with every satisfaction, a fact so significant that it recalls the old proverb—'the proof of the pudding is in the eating.'"

OUR GUTTA PERCHA SUPPLY.

IN the twelfth number of the "Journal of the Straits Settlements branch of the Royal Asiatic Society" is published a valuable paper on "Gutta percha-producing trees," by Mr. J. L. Wray, jun., curator of the Perak Museum.

This paper will, we hope, be useful in attracting attention to the great loss caused by (to use the words of Sir Hugh Low, President of Perak, who introduces the paper with a few remarks) "the wasteful means of collecting which have alone been hitherto practised; by far the greater part of the valuable product for which the tree is destroyed remains in the bark, which is left to rot in the jungle, so that not more than the merest fraction is made available for the demands of commerce."

Sir Hugh Low goes on to say: "The process necessary for extracting the whole of the gutta, Mr. Wray describes as a simple maceration of the fresh bark shred into thin slices, or of the bark dried and pounded; a process so productive of valuable results that he considers the quantity exported from the Straits Settlements might have been gathered from one thirtieth of the number of trees which it is estimated must have been destroyed to produce it."

Sir Hugh is much impressed with the value of this process "*to such States that still have a supply*" of gutta-producing trees. (The italics are our own.)

We are glad that this matter is in a fair way to be intelligently studied, and hope that Mr. Wray will be well supported.

A somewhat similar experiment, on a larger scale, however, was carried out by an exporter of gutta percha in British Guiana about fourteen years ago, who set up plant to boil the bark of the gutta percha tree, after which it was passed through rollers. This process gave an increased production of gutta percha, but, in addition, other juices were expressed, in consequence of which the gutta percha itself was rendered almost valueless, the associated matters oxidising rapidly, and rendering the gutta friable and deteriorating the quality.

Since the unfortunate termination to these experiments no further steps, as far as we are aware, have been taken in this direction until now, and Mr. Wray is to be thanked for bringing a matter of so much real and increasing importance into a prominent light in the able way he has done.

We publish an extract from this paper relating to the utilisation of the bark.

"*On the great loss of gutta, resulting from the wasteful mode of extraction employed by the Malays.*

"Whilst engaged in collecting specimens and information respecting the gutta-producing trees of Perak, I was greatly struck by the exceedingly small amount yielded by even large trees, by the present Malay method of ringing the bark; which led me to an examination of the dried bark, with a view to ascertain, by a series of careful experiments, what proportion of the whole amount of gutta contained in a tree was actually left in the bark after the usual process of extracting it had been performed. With this object, I had, on the 24th of May, 1883, a tree of *Getah Taban Simpor* felled, and scores cut in the bark, at distances of fifteen inches along the whole length of the trunk; and obtained 12 ozs. of gutta. Some two or three days after, I had some of the bark removed, and on the 29th, I cut some of it up into thin slices, across the grain, and boiled them in water for a short time, when I found that gutta had been expelled and remained as a slight and irregular coating on the chips. This I picked off, and weighing it, I found the yield to be $3\frac{1}{2}$ per cent. of the weight of the wet bark operated on.

"Encouraged by this simple and satisfactory experiment, I next had a weighed sample of bark pounded in a mortar, and then transferred it to a glass vessel, and boiled it in water. In a few minutes the gutta formed itself into small detached white flakes, and by stirring, collected into a mass, which was easily removed from the flask, and purified by reboiling in clean water. By this method the sample of *wet* bark yielded 5·3 per cent. of clean white gutta. Another weighed sample of bark was cut up and dried in the sun, and then put into chloroform, and after standing some hours, with frequent shakings, the liquid was poured off, and allowed to evaporate; fresh chloroform being added to the bark to extract any gutta which remained in it. The total product thus obtained was 5·7 per cent. of the weight of *wet* bark used in the experiment. I next took a weighed sample of wet bark and cut it up into small chips, and dried it thoroughly, and found as the result of several experiments that it lost 50 per cent. of its weight in the process. The following deductions may be made from these results:—*Firstly*, that the wet bark, which is now allowed to rot in the jungle, contains fully 5·7 per cent. of its weight of gutta percha, or when dried 11·4 per cent.; and, *secondly*, that by simply pounding or rasping, and boiling the bark, nearly all the gutta which it contains may be extracted. After the tree was felled I made careful measurements of it, and weighed portions of the bark, so that I could calculate the total weight on the trunk of the tree, up to the first branch, which I found to be 530 lbs. when in the wet state. Now if we take 5·3 per cent. of this, as being the amount of gutta that may be extracted by the process of pounding and boiling already specified, we find that it would yield 28 lbs. over and above the 12 ozs. which were obtained by the ordinary Malay method; or, to put it in another way, that for every pound of gutta collected at present, 37 lbs. are wasted!

"In the Kew Report for 1881, I find it stated that, in the year 1875, the export of gutta from the Straits Settlements and Peninsula was estimated at 10 millions of pounds weight. I have no means of ascertaining the accuracy of that estimate, but accepting it as being tolerably correct, we must, from my experiments, come to the conclusion, that even that collected, there were, during *that one year*, no less than 300 millions of pounds, or putting the price at only 2s. 6d. per pound, £37,500,000 sterling worth of gutta percha thrown away and utterly lost! To fully realise the importance of this subject it must be borne in mind that this vast destruction of these valuable trees (which are of such very slow growth) and of this *material*, on which the communication of the world may be said in a measure to depend, is going on *every* year, without any cessation whatever. It will be noticed that I have left out of my calculations all the bark on the upper part of the trunk, and on the branches, which, however, is just as rich in gutta as the lower portion of the trunk: even the leaves contain a notable proportion. I have tested, also, other varieties of these trees, and have obtained almost identical results, therefore I need not enter into further details.

"The question naturally arises, can the bark be broken from the trees, and dealt with in the country, or can it be dried and sent to Europe, to be ground up and treated in the manner I have described, or in some other way sufficiently economical, as to be commercially successful? This question deserves the most anxious attention, especially of those who are engaged in the working up of this material; for if it can be successfully accomplished, then the same supply could be furnished, with *one-thirtieth* of the present annual destruction of trees."

THE "SUN" LAMP.

[A COMMUNICATION.]

(*Continued from page* 29.)

MEASURING INSTRUMENTS.

BEFORE undertaking the study of the electrical measurements, M. Clerc considered what instruments could be employed, and how they could be employed, with an alternating current.

He adopted the Siemens ammeter and wattmeter. He found that the ammeter, having no possible induction, the nature of its indications suited the two natures of the current. In fact, having placed on the circuit an ammeter with an iron core, like his own, of which we shall speak later on, he saw that the two instruments agreed perfectly whether the current was continuous or alternating. That is to say, that for a given indication of the Siemens ammeter the weight supported by a coil is the same whatever may be the nature of the current.

This is not the case with the Siemens wattmeter. We know that in this apparatus there is the reaction of a coil fixed of enormous resistance to a frame of two wires, through which the current of the circuit passes.

The action of the coil is in proportion to its intensity, *i.e.*, in the ratio $\frac{E}{r}$, E being the fall of potential between the two parts of the circuit touched, and r the resistance of that coil.

It was to be presumed that indications would not be the same with the two currents, taking into consideration the reciprocal induction of the spirals of wire. With alternating currents r must increase, and the apparatus give too low results.

What coefficient must be employed in order to correct the indications of the apparatus?

M. Clerc used to find that coefficient by the following process :—

He stretched a straight wire sufficiently thick not to heat. He introduced into it a direct current of 10 ampères. For this length of wire the ammeter indicated 660 watts.

He passed into the same wire the alternating current of a Gramme machine, and regulated the current to have with the same ammeter 10 ampères. For the same intensity and for the same wire the wattmeter only indicated 600 watts.

Passing into the same wire the current of other alternating machines he found that the indications varied very slightly, the alternations varying from 8,000 to 12,000.

Thus the apparatus indicated 600 watts instead of the 660 that it should have indicated. Therefore with an alternating current we must employ a coefficient

$$K = \frac{660}{600} \quad K = 1{\cdot}1.$$

It now remained to find out whether the apparatus was reliable as to comparison, *i.e.*, whether for the same intensity the number of watts increased in the ratio of the resistance.

It was necessary to make sure that when E increased, *i.e.*, when the intensity of the current passing through the resisting coil increased, the resistance of the coil did not.

For this purpose M. Clerc stretched four rectilinear wires of the same length in four directions.

He ascertained that at 10 ampères of an alternating Gramme each wire required 430 watts.

He placed them end to end in succession, and found for 10 ampères—

1 wire	430 watts.
2 ,, ...	860
3 ,, ...	1,290 ,,
4 ,, ...	1,720 ,,

i.e., that even for alternating currents the Siemens wattmeter is reliable as regards comparison, which is easily explained by the absence of soft iron in the apparatus.

With a comparable apparatus for the alternating current it became easy to measure the resistances of any apparatus whatever, burner or machine, and that with exactness.

Now, with an alternating current what are the values of E and I, indicated in these apparatus; are they the maximum or mean of the alternating phase? We shall later see.

As an industrial measuring apparatus for continuous and alternating currents, M. Clerc has combined an ammeter and a voltmeter.

These instruments are based on the same principle.

A cylinder of soft iron outside a bobbin is attracted to it with more or less force, according to the intensity of the current. The cylinder of soft iron is placed above. Two counterpoises balance it round a pivotted axle. One of the weights is placed on the same line as the point of suspension of the cylinder and keeps it in equilibrium. The other is placed at 45° from the first, so that its weight increases as the soft iron cylinder enters the coil, and that in such a manner that the divisions of the apparatus are about equal on the entire scale of indications. By shifting this last weight the instruments are regulated to act according to the different industrial purposes for which they are required. The ammeter is of small dimensions. It is graduated empirically with the Siemens ammeter and with a continuous current. The two instruments being then placed on the alternating current agree perfectly.

The voltmeter is of larger dimensions with a very high resistance, which is made with a stout wire. It can bear permanently 1,500 volts.

It must be graduated empirically for the continuous current and for the alternating current with the Siemens wattmeter. There is no coefficient, for here, with the alternating current, the resistance varies with the position of the soft iron.

These two instruments, which are strongly made and capable of regulation, according to whether a more or less extended scale or a greater or smaller sensibility is required, are really suitable for industrial purposes.

In electrical measurements relating to dynamos and burners, there is one important item which is more difficult to estimate; *i.e.*, the internal resistance of the machines. In alternating current machines, there are in the induced coils inductions which considerably change the resistance calculated according to the length and diameter of the wire.

How is this resistance to be measured? It seemed to M. Clerc that if one introduced into a machine the alternating current of a similar machine of the same intensity, the inductions in the coils would be the same as when the machine revolves.

It will be sufficient to take an average of the resistances obtained for different positions of the armature, and this average resistance can be considered as the internal resistance of the machine. This method can be applied either to continuous or alternating current machines.

If a continuous current machine which is not allowed to revolve is traversed by a continuous current of an intensity heating it to the ordinary degree, we shall obtain from the fall of potential observed, and the intensity employed, the resistances of the different parts of a machine. This method having been applied to a Gramme machine, workshop type, it gave :—

Ring ...	0·43 ohms.
Inductor ...	0·61 ,,

For alternating current machines M. Clerc first studied, in May, 1883, an alternating current Gramme of 20 Jablochkoff candles working normally at 9 ampères. M. Clerc found that a current of 9 ampères being introduced into the circuit formed by the quarter of the machine, the resistance of this quarter was 27 ohms. If this same quarter were measured after the current had been sent into the next quarter, the resistance of the first became 16·5. On the current being sent into the whole of the machine the resistance of each quarter becomes 10 ohms; *i.e.*, the resistance of the entire machine at 9 ampères is 40 ohms. These figures give the mean resistances obtained for various positions of the armature, the maximum difference being 6 per cent.

With these machines if three Sun lamps are lighted by a quarter of the machine, they only show 6 ampères. If three are lighted on the neighbouring circuit, they all show 8 ampères. If the whole machine is used, they all mark 9 ampères. These variations are explained by the variations in the internal resistance. Further, for machines with several circuits requiring to work independently from each other if necessary, the grouping is an important item, and that mode of grouping should be chosen which gives the lowest internal resistance in every independently working circuit. For example, in the machine in question, let us call the bobbins in their successive order 1, 2, 3, 4, 5—14, 15, 16.

The grouping of the machine quoted from is 1, 3, 5, 7 in a circuit. We can light three feeble lamps on a single circuit. In other machines the grouping is 1, 5, 9, 13, and there is no appreciable trace of any current, the internal resistance becoming so enormous for the quarter working alone.

Therefore, for a Gramme machine of 20 Jablochkoff candles, we get as internal resistance at 9 ampères, the whole machine being at work, 40 ohms.

If we calculate or measure the resistance of this wire with a continuous current we get 21 ohms. The effect of the inductions has almost doubled the resistance.

Recently *La Lumière Electrique* estimated the resistance of this machine at 108 ohms. The total resistance is thus evidently estimated at four times that of the quarter working alone—hence the error.

The same may be said for the enormous resistance of a Maquaire coil. If we take such a machine with all its coils in position, *i.e.*, with all the soft irons able to react upon each other, we get as the resistance of a machine with a current of 9 ampères 46 ohms, the current used being that of a Gramme machine. This result might be different, but very slightly different, if the current of another Maquaire machine were used. The resistances must be taken as when the machine is at work.

In machines where there is no magnetic action, no increase of work is observed when the current is made to pass from the exciter into the inductor, instead of being made to pass into an equal resistance. In these machines the force absorbed by the internal resistance of the machine will be in the ratio of the measured resistance. Where there is magnetic action the question is more complex, and the internal resistance only represents one feature of it.

The work due to the magnetic action must be known as well.

In the machines of the Wilde type there is only magnetic work, and that work is as much greater as the resistance of the circuit is greater.

In these machines the electromotive force increases almost in the ratio of the external resistance, as the intensity remains constant; hence the increase of work.

In all alternating current machines the case is a little similar, *i.e.*, that the electromotive force increases more rapidly than the intensity diminishes, for the work increases notwithstanding the decrease in intensity.

As regards the rendering in the machines, there is, in addition to the work due to magnetic action and the work due to external resistance, the work required by the inductors; and it is by taking into account all these elements, without forgetting the mechanical one, that we can arrive at the best machine as to rendering from the point of view of the force absorbed as much mechanically as electrically.

Thus it is only with the help of diagrams or dynamometers that we can absolutely compare the rendering of the machines. As to the measurement of the internal resistance, it is only of interest in machines without magnetic action.

For machines with this action it cannot give an idea either of the number of lamps, or of the force required by the dynamo for itself, the question being too complex.

Burners.—With the same instruments M. Clerc also measured the resistance of the burners, especially the Sun lamp. Here a more complicated question presented itself for solution.

With an alternating current the arc lamps go out and relight at each change. The curve of intensity must be interrupted, for it falls suddenly to zero during a considerable portion of the phase. Then when the electromotive force increases again the lamp will be relighted. At the moment of relighting the resistance of the lamp is at the maximum; the electromotive force will have to pass almost through the maximum before increasing again, and passing through the maximum of the phase. Then the intensity will diminish, become lower than lighting point, and fall suddenly to zero. In the case of these suddenly interrupted phases, so difficult to measure, does not the coefficient of the alternating current instruments change from that established above for complete phases with a metallic circuit? To ascertain this M. Clerc acted as follows:—He placed on the same alternating circuit a Sun Lamp and a metallic resistance capable of being regulated. With the current of 10 ampères he measured on the wattmeter 1,130 watts for the work of the lamp of 25 millimetres at 10 ampères. Then he found what length on the metallic resistance also gave 1,130 watts.

He then suppressed the lamp, and added the wire necessary to obtain again 10 ampères. Then measuring the necessary work by the work of this added wire, he again found 1,130 watts; *i.e.*, that the indication of the apparatus is in accordance whatever may be the nature of the phase. The coefficient is therefore still 1·1 in all cases, and henceforward our figures will take into account this coefficient. In the case of the interrupted phases, the resistance of the lamp is variable; there is a mean, and this mean can be regarded as equal to the resistance indicated by the wattmeter, for if this apparatus is affected by the alternating phases, and does not exactly mark the average of I, it is affected parallel to the ammeter, and as it is from the indications of the ammeter and the wattmeter that the resistance is deduced, we can regard the figures obtained as representing the actual value of the resistance to be measured.

Knowing the resistance of the lamps, M. Clerc wished to compare as to measurements and light the lamps fed by a continuous current of 10 ampères and those fed by an alternating current of 10 ampères. As regards light the lamps were about equal, showing a slight superiority with the alternating current.

With the Sun Lamp this result can be foreseen, for the carbons are not seen as in the other arc lamps.

In fact, the whole of the light proceeds from the marble, which constitutes a reservoir of light and heat.

The eye can only judge of the brilliancy of the light and not of the quantity, which can only be determined by chemical action.

For the lamp to be more brilliant with the alternating current, it must receive a series of more bright flashes during a short period of each phase.

Now, if the ammeter indicates 10 ampères with the alternating current, it may indicate an intensity near the maximum but not the maximum itself, and probably the impression on the eye is nearer the effect of the maximum than the indication of the instrument. The storage of heat by the marble helps in the persistence of the impression on the eye.

The electrical measurements we get are as follows:—

Lamp	25	millimetres,	continuous	current	10 amp.	960 watts.
„	„	„	alternating	„	„ „	1,130 „

From this we get for the resistance

With a continuous current	... ...	9·6 ohms.
„ an alternating „	... ...	11·3 „

With an alternating current, therefore, the resistance increases 17 per cent. with the Sun Lamp. Is this the case with other arc lamps? The coefficient may alter slightly.

This result is easily explained, for with an alternating current the lamp must be relighted at each phase, and at the relighting the resistance is much higher.

Force.—After having compared the lamps as to resistance and light with the two currents, M. Clerc commenced the important study of the force required.

With the continuous current there was no difficulty; by using the formula $\frac{E\,I}{746}$ the force in horse-power is obtained.

But in the case of alternating currents can we accept for this formula the indications of the ammeter and wattmeter?

What is I furnished in this case? Is it $\sqrt{\varepsilon\ I^2}$ or is it a quantity approximating to $\varepsilon\sqrt{I^2}$, or is it a quantity nearer to the maximum of I than to its average.

As we shall presently see, with a Gramme of 20 candles, in order that the figure indicated by the ammeter may give about the true dynamic power with the alternating current of this machine, the intensity indicated by the ammeter must be divided by 1·225 or multiplied by 0·816. This is accounted for by the fact that the indication of the apparatus is too near the maximum of intensity and does not indicate the mean.

The ammeters are quite idle owing to their mass, and they somewhat resemble the eye in that they are incapable of judging exactly the quantity of the intensity, but only a series of shocks very near together, indicated by the rustling of the instruments, and the indication of the apparatus is too high, registering too near the maximum.

In order to measure the dynamic coefficient of an ammeter, we must have recourse to dynamometers or diagrams of steam engines. Dynamometers are more sensitive and more convenient, but they are difficult to obtain for high forces.

M. Clerc was obliged to use the diagrams.

The Sun Lamp Company has an installation in the South Kensington Museum of 40 Sun Lamps of 25 millimetres, working at 9 ampères. On an installation of 40 lamps the figures enable us to arrive at a good approximation in the measurements, and to obtain very reliable industrial values.

To light 40 lamps, two exciters are used and four Gramme machines, 20 Jablochkoff candles type, at a speed of 850 revolutions. The exciters work at 25 ampères, the lamps at 9.

A lamp of 9 ampères with 25 millimetres of marble requires 1,073 watts with the alternating current, which gives as resistance 13·25 ohms.

The diagrams have been taken with several kinds of indicators. It was found that:

For 40 lamps when lighted, 90·5 H.P. were indicated, the current of exciters being 25 ampères. M. Clerc then suppressed 32 lamps, keeping 8 alight, *i.e.*, one on each circuit to retain the suddenly-interrupted phases. By the help of resistances placed on the circuit of the exciter, he brought back the 8 lamps to 9 ampères.

The circuit of the exciter then worked at 18 ampères. 46·8 horse power were then indicated.

M. Clerc then suppressed the eight lamps, and the alternating circuits were open. The exciters giving 25 ampères, 24·5 H.P. were indicated. He took the diagram, adding on to the circuit of the exciters the resistance, thus bringing the intensity to 18 ampères.

He then found 21·25 horse power indicated. He then cut off the current of the exciters, and found 13·1 indicated.

He slipped off all the belts with the exception of those moving the transmission. The indication was then 8·6.

Finally, slipping off these last, the indication for the machine working freely was 6 horse power.

What conclusion is to be drawn from these results?

It must first be seen what number of effective horse power they each represent. Experiments with the brake showed that for 100 indicated horse power this machine gave 72·5 effective H.P.

This rendering is normal, and can be accepted for a semi-fixed machine at great speed. Thus, when the indicated work increased from 6 to 100, the effective work increased from 0 to 72·5.

Thus, the formula representing the effective work of N indicated horse power, is

$$(N - 6)\frac{72{\cdot}5}{100 - 6} = (N = 6)\,0{\cdot}77.$$

We can therefore estimate the effective work with a certain degree of precision.

We shall thus get:

		Indicated H.P.	Effective H.P.
40 lamps at 9 ampères	...	90·50	65·1
Exciters at 25 „	...	24·5	14·1
8 lamps at 9 ampères	...	46·8	31·45
Exciters at 18 „	...	21·25	11·77
All circuits open	...	13·1	5·5
Belts of dynamos removed	...	8·6	2
Transmission belts taken away		6	0

The transmission, therefore, when the machine is working freely requires 2 H.P.

When the machine is at work this number will not increase much, for the belts are placed on each side of the transmission.

This number agrees with the calculation, if we understand a coefficient of friction of 0·055.

5·5 — 2 = 3·5 represents the work of the dynamos working freely, which quantity agrees with the calculations. This number, when the machines are at work, will increase to 4·5 from the pulling of the belts. 11·77 — 5·5 = 6·27 represents the work when the exciters are at 18 ampères.

The work due to the exciting current is that of four inductors of a resistance of 1·7 ohms; two exciters of a resistance of 1 ohm; a rheostat of 5·7 ohms; or 4 × 1·7 + 2 + 5·7 = 14·5 ohms.

At 18 ampères the work is 14·5 × 18² = 4694 watts; *i.e.*, in horse power $\frac{4694}{746} = 6{\cdot}12$ horse power.

Thus, the difference with the horse-power given by diagrams, 6·27 H.P. — 6·12 H.P. = 0·15, gives the work of the magnetic action, and the increase of work in the bearings.

This shows that the work of the magnetic action is 0 in the Gramme machine, as is already known.

14·1 H.P. — 5·5 H.P. = 8·6 H.P. represents the work of the exciting current at 25 ampères. Here the rheostat is only 1·5, and the total resistance is 10·3. The work $= \frac{10{\cdot}3 \times 25^2}{746} = 8{\cdot}6$. We see that the figures agree electrically and mechanically,

31·45 H.P. — 11·77 H.P. = 19·68 H.P.

These figures represent the work of the alternating current in the dynamo, and of the eight lamps with a current of 9 ampères + the increase of work of the bearings, which is about 0·4.

Therefore, 19·68 — 0·4 = 19·28 H·P. are the work for the dynamo (for the internal resistance) + the work of eight lamps at 9 ampères.

65·10 — 14·1 = 51 H.P. represent the work for the dynamo + the work of 40 lamps + the increase of work of the bearing, which is in that case 1 H.P.

Therefore, 50 H.P. = the work of the dynamo + the work of 40 lamps at 9 ampères.

Hence, 50 H.P. — 19·28 H.P., or 30·72 H.P. represent the dynamical work equivalent to the electrical work of 32 lamps with an alternating current of 9 ampères.

The work of one lamp will be $\frac{30{\cdot}72}{32} = 0{\cdot}96$ H.P. per lamp. The 40 lamps therefore take 40 × 0·96 H.P. = 38·4 H.P. of the 50 H.P.

The difference 50 — 38·4 H.P. or 11·60 H.P. represents the equivalent of the internal work of the four Gramme machines with an alternating current of 9 ampères.

The work indicated by the wattmeter for one lamp of 25 millimetres at 9 ampères is 1,073 watts, or $\frac{10{\cdot}73}{746} = 1{\cdot}44$ H.P., instead of 0·96; *i.e.* $\frac{1{\cdot}44}{0{\cdot}96} = 1{\cdot}5$ times too much as to dynamical work.

In this estimate of the work $= \frac{R\,I^2}{g}$ we have explained that we can accept R as given by the wattmeter; it is with regard to intensity that the instruments give too high values, nearer the maximum than the mean.

With regard to resistance, as to the number of volts required, the instruments give a figure which can be accepted after the instruments have been corrected for the alternating circuit. But it is very certain that, applied to get a mean of the work, they are no longer correct, and give a mean that is too high.

In order to estimate the work, we must multiply the figures of the wattmeter that are applicable to the alternating current by $\frac{1}{1{\cdot}5}$ or 0·66.

As to the ammeter, we must multiply by $\frac{1}{\sqrt{1{\cdot}5}}$ or $\frac{1}{1{\cdot}2255}$, or 0·816 when we apply the indicated intensity to the calculation of the work.

These coefficients will certainly be variable according to the nature of the circuit. For other arc burners it is probable that the variation will be slight.

But, on the contrary, a greater change is to be expected when the external circuit is metallic or closed with incandescence lamps.

As to its varying with the dynamos, it does not seem likely that the variation should be great.

These coefficients can be accepted as accurate for industrial purposes in the case of arc lamps.

We have seen that the internal work of the four dynamos has been measured equal to 11·60 H.P. or 11·60 × 746 =8,653 watts. We have also found that for similar work the wattmeter would indicate 8653 × 1·5 or 12,980 watts. Therefore 12,980 watts $= \text{R I}^2$. Here R is the internal resistance of the machine, and I is equal to 9. Thus $\frac{12980}{9^2}$ or $\frac{12980}{81}$ or 160 ohms represent the internal resistance of the four Gramme machines at work at 9 ampères, a value which agrees well with the resistance of 40 ohms per machine at work measured directly by M. Clerc. We know, then, that in order to maintain 40 lamps at 9 ampères with six machines, the rendering of which is not the highest, and which require an increase of mechanical work from their large number, we want as the total of work, electrical or mechanical, 65·10 H.P., and that with a transmission requiring 2 H.P.

If we maintained these 40 lamps with an exciter and a large dynamo, we might suppress the transmission and economise 2·1 H.P. as the mechanical work of the dynamos.

We may say, therefore, that with 61 H.P. we get 40 Sun Lamps of 25 millimetres at 9 ampères.

One lamp therefore requires $\frac{61}{40}$ or 1·525 horse-power (every lamp giving a light of 1,400 candles) for the whole electrical and mechanical work.

These figures, established upon a large installation, are beyond question. They show how groundless were all the attacks declaring that the Sun Lamp required an enormous amount of force.

The rendering is therefore $\frac{1400 \text{ candles}}{1{\cdot}525 \text{ H.P.}}$ or 900 candles per H.P. of electrical and mechanical work of the lamp with a marble of 25 millimetres and at 9 ampères. We have seen that with a marble of 30 millimetres, and with a current of 12 ampères, this rendering increases to 1,100 candles.

The Sun Lamp can no longer, therefore, be attacked as to the force required, or as to the rendering in light, which has been the most common objection raised against it; which is easily explained by the impossibility of refuting such attacks in a manner convincing to the public.

Not being able to attack the light or the simplicity of the lamp, which can be judged of at sight, its detractors have found fault with the force required to work it. Hence the erroneous idea that the Sun Lamp requires an enormous amount of force.

Now, if, instead of alternating current machines, the lighting should be produced by 40 lamps fed by a continuous current of 9 ampères, what force would be required? We know that the light would not be stronger. At 9 ampères a lamp fed by a continuous current requires 920 watts, For 40 lamps we should get, therefore, 920 × 40 or 36,800 watts in the external circuits.

Let us take some machines giving an electrical and mechanical rendering of 70 per cent., which for continuous current machines is a satisfactory number for machines at high tension; the total work for machines and lamps will be $36{,}800 \times \frac{100}{70}$ or 52,575 watts as the total work or $\frac{52{,}575}{746}$ or 70·40 H.P.

About 70 H.P. would, therefore, be required with a continuous current instead of 61 with an alternating current.

These figures, although approximate, show that for the Sun Lamp, which does not give more light with a continuous current (for in other arc lamps the positive pole greatly increases the useful effect), the employment of the alternating current is not without its advantages, for it requires rather less force with an equal light.

In order that the currents should take the same force it would be necessary for direct current that the electrical and mechanical rendering should rise to 81 per cent. for the external circuit.

Besides, the alternating current machines have no collector, an apparatus that renders the continuous current machines delicate and requires constant attention.

It will no doubt be urged that the continuous current gives silent lamps, and is less dangerous.

As regards the silence of the lamps, there is no great advantage for the Sun Lamp, which can burn enclosed in a lantern, and is made silent with the alternating current.

As to the continuous current being less dangerous, M. Clerc contradicts this theory.

At high tension the two currents kill with equal certainty, and the alternating current has the advantage of giving warning.

If with an alternating current a point of the circuit is touched, a shock is produced in the arm which turns the hand away from the point in question without one being conscious of it. A shock of this kind gives warning that one point of the circuit is in contact with the earth.

Even when there is no contact with earth one always experiences, at least on the circuits with arc lamps, a slight static commotion of some sort, which prevents one from leaving one's hand on any part whatever of the circuit, and prevents one from being accidentally seized by the current if any other part of the body should happen to touch another part of the circuit.

It is not the same with a continuous current.

If the man killed at the Health Exhibition had not been able to rest his hand permanently on one of the brushes he would not have got into the habit of touching it, and he would not have been seized by the current when by accident he touched with the other hand the other brush or some other point of the circuit.

In fact, if one is struck by the current, in the case of the alternating current—and M. Clerc has been struck gravely when in the Jablochkoff Company at Ostend—one utters involuntarily a violent cry, and the body is shaken so violently that it is impossible the accident should pass unnoticed if any one is near the person touched.

With a continuous current the shocks do not exist, the attitude changes very little and nothing is noticed, as at the Health Exhibition.

The difference between the two as regards danger is as it would be between coal gas similar to the ordinary gas, but inodorous, and the ordinary gas. With high tensions there are unavoidable inconveniences, and the warnings of the alternating current are necessary. The employment of the alternating current will, besides, allow of the employment of secondary generators, which will be very useful for circuits of too great resistance if great numbers of lamps are placed directly above.

As to the transport of force, the question of rendering is not yet sufficiently established; but everyone knows that for receiving motors, the collector, that delicate part of continuous current machines, will be a source of difficulty. If the force required from the motor should vary much, will not the sparks be very destructive?

Besides this, the collector requiring to be cleaned, it will be needful sometimes to touch that part of the machine forming part of the circuit. With high tensions this will be a source of danger.

In a different way it will be possible to use the receiving motors furnished with high tension currents to move a new dynamo which will distribute low tension current. But in that case, with that transformation, how low will the rendering fall?

With alternating current those difficulties can be overcome.

It would be sufficient to employ small magneto-electric motors, thus dispensing with the commutator which is also a delicate apparatus; and in that case we should get a motor absolutely perfect from a practical point of view. Perhaps the permanent magnets might become weak, but it would be sufficient to have one in reserve and to re-magnetise the one replaced.

With these motors and secondary generators we can use motors working at a low tension and absolutely safe.

As for a distribution with alternating currents, the loss for the cable will be the same as with direct current, smaller, probably, because as collectors will not be wanted, currents of higher tension can be used, and with secondary generators the loss, for the transformation of high tension currents into low tension currents, will be only 10 per cent., as these apparatus give in watts for the secondary circuit 90 per cent. of the current given to the primary circuit. The commutators would be used when chemical actions are wanted, and by these dispositions an electric distribution for light and power would be complete, economical, and little dangerous.

These are the reasons that have led to the adoption of alternating current machines for the "Sun" Lamp, not to mention that continuous current machines cannot be easily adapted to the division in circuit, and we should have to use for a large number of lamps either a large number of dynamos or very high tensions, the extra current of which no insulation would resist if the number of lamps was a little large.

In small installations of 1, 2—5 and 6 lamps continuous current machines are used, having the inductor in derivation on the circuit.

Above six lamps alternating current machines are used, unless the others are specially ordered.

Conclusion.—We have sufficiently shown that, thanks to the improvements made, the Sun Lamp Companies have all that is needful to make them succeed, especially as their entirely unique system has no rival, and, as combining the fixity of the incandescence lamps with the economy of the arc, the lamp should come into general use as much for industrial purposes as an article of luxury.

With regard to the latter, it has been shown that incandescence cannot enter into competition with gas, being too expensive for the effect produced. As to the arc lamps, they have been rejected from the first as unsuitable on account of their blue and unsteady light. This is why the Sun Lamp alone is adapted to the establishment of a central lighting station, and the future of the electric light lies more in the sale of the light than in the sale of installations, since, with limited capital, a considerable amount of business can be done, and good dividends can be given on the condition of having a sufficiently good and powerful light to sell it at a remunerative price.

These central stations will only be possible when obstacles coming from the Board of Trade can be overruled. We must hope it will be soon.

The first companies working the Sun Lamp have suffered from administrative incapacity, as is the case with all rising industries.

In an undertaking, when in progress, a board is necessary as a guarantee of honest administration, but in an undertaking when at its commencement, where it is not a question of honest but skilful administration, boards are an obstacle to every prompt decision, and the directors are too little acquainted with electrical affairs to direct business with skill.

The excellence of the Sun Lamp—confirmed by three gold medals, one in Paris Exhibition, 1881; one in London, Health Exhibition, 1884; one in Rouen Exhibition, 1884—will in the end triumph over obstacles of administration; but how much time will have been lost! Let us hope that the establishment of a first central station will soon inaugurate era of success.

L. C.

PHOSPHOR-BRONZE TELEPHONE WIRES.*

THE sudden storm of snow which raged in Belgium on the 9th December caused serious damage to the telephone wires, particularly at Brussels, where about 130 of these wires were broken. But this disaster has its lesson. It has been ascertained that out of all the broken wires there were only two of phosphor-bronze broken at imperfect joints. All the others were of iron, or of galvanised steel.

But at the same time it must be understood that the storm which brought about this state of affairs was nothing out of the common; and one can only account for the breakage of so many wires by reason of their decayed state, they, as a rule, lasting barely four years.

I have again and again in *L'Ingenieur-Conseil* insisted upon the small amount of confidence which ought to be placed in iron or steel wires of a diameter of two millimetres. I have pointed out that the oxidation which is constantly going on in these wires reduces this diameter in a short space of time to breaking point, and that the smoke from the chimneys hastens this process of oxidation, and consequently the destruction of the wires. Convinced of the importance of these facts, I have, notwithstanding the opposition of eminent specialists, exclusively adopted for telephone wires the phosphor-bronze of M. Montefiore; and, going still further, have constructed the whole system in use at Ghent, together with the new lines I have run at Brussels, of phosphor-bronze wire, having only a diameter of 0·8 mm. All these wires wear well, whilst the destruction of iron or steel wires has already commenced.

The Bell Company, which at first refused to follow my example, has at length been induced to take a healthier view of not only its own interests, but of those of its subscribers. At the present moment it uses exclusively the Montefiore phosphor-bronze wire, but that employed is 1·25 mm. in diameter. The company is perhaps right to act thus, these wires being easier to run than those of 0·8 mm., and naturally offering a further guarantee against accidents. The company has thus been enabled to run trunk lines; that is to say, a whole bundle of wires with a span of 260 metres. At Lacken, for the use of the royal palace, there is even a line of 700 metres in one single span.

The Italian Company has likewise adopted phosphor-bronze wire 1·25 mm. in diameter for all its lines; and I have no doubt whatever that in a short time, when whole hecatombs of iron and steel wires have been sacrificed in different countries, phosphor-bronze will be universally employed.

I am convinced that people will eventually use for the telegraph wires phosphor-bronze of a high conductivity, which is constantly being turned out at M. Montefiore's factory.

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* *L'Ingenieur-Conseil*, 15th December, 1884.

Without doubt, telegraph wires with a diameter of at least four millimetres will wear much longer than telephone wires of only two millimetres, because the same degree of oxidation produces a far smaller proportionate reduction in the diameter; again, the spans of these wires are much shorter, hence the strain upon them is not so great. But granted that these wires only break after a greater lapse of time, they soon become, nevertheless, bad conductors. It is clear, for example, that oxidation to the depth of half a millimetre, thus reducing the diameter of the wire from four to three millimetres, increases the electrical resistance in the ratio of nine to sixteen.

There is, therefore, a good reason for replacing iron or steel by phosphor-bronze in the telegraph lines, and an absolute necessity for so doing in the telephone lines.

In conclusion, I will add that the phosphor-bronze wires of 0·8 mm. in diameter which I have had the opportunity of examining after one year's wear, have retained in all respects both their diameter and their original strength.—E. B.

[For telephonic purposes the employment of *phosphor* bronze wire is unobjectionable as a high specific resistance is not of importance; only so far can we agree with the author of the above paper, as for telegraphic use *silicium* bronze which has a conductivity approaching that of copper would be necessary.—EDS. ELEC. REV.]

NOTES.

Lighting of Proposed Subways in the City.—At a meeting of the City Commissioners of Sewers on Tuesday, a scheme for constructing a series of subways in front of the Mansion House, to obviate the danger of crossing the crowded thoroughfare and to facilitate the traffic, was discussed and met with general approval. The proposal included the electric lighting of the subways.

Cost of Lighting Ships of War.—The Dockyard authorities at Portsmouth purpose instituting an exhaustive experiment with the view of determining the comparative cost of lighting ships of war with the usual oil lamp and the electric light. The experiment will be made on board the *Colossus*, which is fitted with the most thorough installation yet attempted on board ship. The dynamos will be driven continuously for seven days and nights, careful observations being taken of the consumption of coal and oil during the trial.

Edison Lamps in France.—Edison lamps have lately been installed at the following works in France:—50 at Toffin's lace manufactory, Caudry; 40 at Chaffrée's foundry, Le Mans; 50 and 8 regulators at Cointraux' distillery, Angers; and 25 at Lorthillois' Spinning Mills, Tourcoing.

The Edison Light at Vienna.—The offices and printing rooms of the *Neues Tageblatt* of Vienna are lighted by 300 Edison incandescent lamps.

The Electric Light in Docks.—For over three years the Port of Havre, France, has been employing the electric light in unloading vessels, and its use has now been extended to its graving docks. Three Gramme regulators, the height of which can be altered with decagonal reflectors, and provided for each quay, the current being led by overhead wires on ordinary telegraph posts. Two F Gramme dynamos, with a special engine, are placed in the building which contains the pumping engines for emptying the docks. Each dynamo supplies two circuits, each with three lamps, while a switch near each lamp permits of turning its current on or off. Sautter and Lemonnier, of Paris, furnished the plant.

Giving up the Electric Light.—It has been for some time rumoured that the Caledonian Railway Company was going to do away with the electric light at Grangemouth. On Monday this was carried into effect, and the docks had a most dismal look after the brilliant light that has been enjoyed for the last year.

The Electric Light on a New Zealand Liner.—Last Tuesday the *Tainui*, the latest addition to the Shaw, Savill and Albion Company's fleet of steamers, went down the Clyde on an experimental cruise. The vessel has been built of steel by Messrs. William Denny and Brothers, Dumbarton, expressly for the direct steam service between London and New Zealand. She is a sister ship of the *Arawa*, which so far has fully borne out the anticipations formed of her by her proprietors and builders both in regard to speed and general seaworthiness. The *Tainui* has a total length of 420 feet, is 46 feet broad, and 32 feet deep moulded, her tonnage being 5,000 tons gross. The vessel is furnished with the electric light, the installation comprising 300 lamps. The plant consists of two sets of Ferranti-Thompson machines, with Siemens exciters, each set capable of supplying 150 20-candle incandescent lights. They are driven by a special engine, made by Messrs. Marshall & Sons, Limited, Gainsborough. The system is divided into 14 main circuits at the main switch-board. These in some cases are again divided into lesser sections by auxiliary switch-boards placed in various parts of the ship. The insulation tests have proved exceptionally high, viz., 60 megohms per light—we presume this means a total of 200,000 ohms—while the loss of energy in the wires is only 5 per cent. The switches are of a special design by Mr. R. D. Smillie, the firm's electrician, and the entire work has been carried out by the staff trained by him, Principal Jamieson, of Glasgow, acting as consulting engineer and inspector for the Shaw, Savill and Albion Company.

Electric Lighting in the City.—The *City Press* states that the Commissioners of Sewers have accepted the contract of Messrs. Hammond & Co. for lighting the following streets by eleclticity, viz.:—Old Broad Street, front of Mansion House, Royal Exchange Buildings, Bartholomew Lane, Lothbury, Princes Street, Lombard Street, Birchin Lane, Bishopsgate Street Within, Throgmorton Street, Threadneedle Street, and Gracechurch Street.

The Electric Light at Hatchett's Hotel.—Hatchett's new hotel in Piccadilly is to be publicly opened on the 19th inst. With the exception of the bed chambers and private rooms, the building will be lighted throughout by Edison electric lamps. The current will be supplied by the latest form of Edison's dynamo machines, driven by two Otto gas engines of 12-horse power nominal, the whole plant being in duplicate to provide against accident. Messrs. Verity and Sons have erected the installation, the engine-room having been specially constructed by Mr. John Waldram, C.E., superintendent of the entire works.

American Telephone Companies.—An American exchange says:—"The Clay Commercial Telephone Company during the early part of this year became defendants in a suit brought by the American Bell Telephone Company, the issue of which will test the validity of the Bell patents. The Bell Company, under a bill in equity filed in the United States Circuit Court, asked for an injunction to restrain the Clay Commercial from operating their present telephones, which, it was alleged, were constructed in such a manner as to be an infringement of the Bell patents of March, 1876, and January, 1877. Counsel for the Clay Company yesterday filed an answer to the bill of complaint. The answer denies that electric-speaking telephones had never been in use before Bell obtained his patents, but, on the contrary, asserts that they had been in use, and were controlled by McDonough, Drawbaugh, Gray, Edison, and 10 other persons, many of whom had obtained letters patent for their discovery prior to the Bell patents. Some 27 patents are mentioned antedating Bell's."

The "Empire" Telephone.—Mr. W. J. Millar, of Glasgow, writing to the *Glasgow Herald* respecting this telephone, says:—"Seven years ago I carried out a number of experiments on the mechanical transmission of sound by wires which were noticed both by local papers and scientific journals. The results of my experiments I submitted to the Physical Society of London, the paper being published in the *Philosophical Magazine* for August, 1878. I found that conversation could be carried on through wires arranged from room to room in buildings, musical sounds were easily transmitted through telegraph wires, but the humming sound due to the wind spoiled the distinctness of word sounds. Curiously enough, I found that speaking, singing, &c., could be transmitted through a common wire fence, consisting of six iron wires, with wooden posts at intervals, to distances varying from 20 to 60 yards. In these experiments, metal, wood, pasteboard, &c., were used as the discs or diaphragms to transmit the sounds to the wire, the same being used at the hearing end. The results obtained were very interesting from a scientific point of view; but it did not appear to me at that time that there was much chance of my arrangements being largely practically applied, as the electric telephone was being introduced for long distances, and the ordinary speaking tube suited well for short distances, such as in buildings."

Greenock Telegraphic Facilities.—In the annual report of the Greenock Chamber of Commerce just issued, it is stated that the directors have repeatedly called the attention of the Postmaster-General to the serious delays which arise in the transmission of telegrams through Glasgow, and have urged the necessity of better telegraphic facilities being provided for Greenock. The result of their action has been that the direct communication with London, which had become very defective, has been put on a more satisfactory footing. They regret, however, that their request for direct telegraphic outlets to Liverpool, Dublin, and Edinburgh, has not been acceded to, and that Greenock continues to have only two direct outlets, namely, Glasgow and London. In view of the increased pressure of business which will arise on the introduction of sixpenny telegrams, the directors have renewed their application for a direct wire to Liverpool, and intend to press it, as such an outlet would not only be of use for telegrams to that port, but would facilitate the transmission of messages to the Midland counties and to Ireland, and be of great advantage to traders generally, particularly to local sugar brokers.

Underground Telegraphs.—A complete system of underground wires has just been finished between Upper Greenock railway station and Greenock Post Office, thus obviating all necessity for overhead wires on the route.

Extension of the Bennett-Mackay Cable System.—The Bennett-Mackay cable system is about to obtain a direct continental line by renting a cable between Waterford and Havre, which will be connected by a land line with the stations on the west coast of Ireland.

The Cape Verde Islands Cable.—On the 9th October last, the ss. *International*, of the Silvertown Company, completed the laying of a cable, connecting San Pedro Bay, St. Vincent, with the town of Praia, Santiago, Cape Verde Islands. On the completion of the underground land line from San Pedro Bay to Porto Grande, the chief town of St. Vincent, the cable was opened to the public on the 20th November. The official inauguration, however, did not take place till the 8th December, when the cable was declared open by his Excellency Joao Paes de Vasconcellos, Governor-General of the Cape Verde Islands, who, with his staff, the diplomatic corps, the municipality and the principal inhabitants of Praia, the capital of the Archipelago, and accompanied by a military guard of honour, visited the company's office. Messages were then sent to and received from the King of Portugal and the Minister of Marine and Colonies, in Lisbon, interchanging congratulations on the completion of this section, the want of which had been felt for a long time. During the afternoon, in all due form, the name of the Plaza "Largo da Bateria" was changed, and declared in future to be called and known as "Largo do Pinheiro Chagas," in honour of Senhor Dom Pinheiro Chagas," the Minister of Marine and Colonies, who has done much to promote the telegraphic union of Portugal with her colonies. In the evening there was a display of fireworks, and the town was brilliantly illuminated.

Electric Light Cables.—Mr. James Johnstone contributes to the correspondence upon this subject in the columns of the *Engineer* this further communication:—" . . . . . I may here repeat that peat is the best of all substances for burying lead-covered cables in. The preserving powers of it are so great that even human bodies are kept by it entire, just as if they had been embalmed. Next to peat is the best clay, fit for puddling with; and if peat or clay cannot be got, black mould, from a garden or field, is better than sand. Mr. Lorrain writes in his last letter:—' Peat, as I have all along said, is by no means a bad material, though I consider sand to be preferable in most cases, because it does not retain water.' Mr. Beckingsale wrote to you: 'As peat can be obtained in the neighbourhood, and as it forms an excellent bedding, impervious to flowing water, and therefore a good preservative to substances embedded in it, I have decided with the authorities to use it.' This sentence, and my writings on this subject, laid before Mr. Lorrain one of the practical reasons why peat is better than sand, namely, that peat prevents the flow of water along the outside of the lead covering, while sand admits the flow of water, and all spring water contains either lime or mineral matters in solution, and the continual flow of such water over lead gradually destroys it. A practical illustration of this I gave in my first letter, namely, that at Auchencastle, near Moffat, in 1858, lead pipes were found which had been buried for hundreds of years, part of them in peat, by which the lead had been preserved, while of a part of them which had been buried in sand the lead had entirely disappeared. With the foregoing information before Mr. Lorrain, why did he write: 'I consider sand to be preferable in most cases because it does not retain water?' The reason here assigned why Mr. Lorrain values sand, is the very reason why common sense condemns it, namely, because it permits water to pass through it, and it is the lime or mineral-loaded water passing through it which destroys the lead when buried. The foregoing remarks refer to one reason why sand should be avoided; but there is another reason why it should not be used. To refer to this I must quote at length the passage in Mr. Lorrain's letter of the 10th December, which I tried to condense in my last letter, but which condensation he objects to as being inaccurate. He wrote: 'Even in the laboratory, with all appliances at hand, it is not always an easy matter to separate the colouring base, as I know well from a series of such analyses carried out by me some years ago in the Chemical Laboratory of the Royal School of Mines, and in subsequent analyses of sands to be used as fluxes for metallurgical operations. As for their being separated from the quartz sand in which the cables are embedded by any probable natural process, and so to act on the lead, the idea is absurd.' In opposition to the foregoing opinion I produced the evidence that an iron pipe which I saw lifted out of the streets of Greenock upwards of forty years ago had on it nodules externally and corresponding nodules internally. The external ones were on their exterior conglomorates of sand and oxide of iron, while the interior of them consisted of a compound of decomposed iron and decomposed quartz, and it was self-evident that the nodules within the pipe were produced by galvanic action, which came through the body of the iron from the exterior nodules. Here we have a process in the ground by which iron and quartz were decomposed, which, so far as I am aware, has not been imitated in our laboratories. There was no appearance of fluoric acid in the bed of sand which lay outside the nodules on the pipe, and there had been no furnace and fluxes there to decompose the quartz, and yet it was decomposed. Having this evidence before us, that quartz can be decomposed in the earth in contact with iron pipes, and seeing that lead pipes are decomposed when laid in the earth in contact with sand, it is a foolish proceeding to trust to laboratory experience about lead and sand not decomposing one another, and in defiance of the foregoing facts, to run the risk of burying lead-covered cables in sand where water might get access to them."

Secondary Batteries.—The correspondence upon the Elwell-Parker and Sellon batteries still proceeds in *Engineering*. In the last number the following letter from F. Maxwell-Lyte, who declares himself to be "Electrolyte" of previous letters, appeared, and a copy of a reply to the same appears in our correspondence columns. Mr. Maxwell-Lyte says :—" In reply to Mr. Sellon's letter of the 19th ult., I would refer him to Mr. Planté's patents of 10th May, 1873, for his battery which he patents in connection with a small apparatus for instantaneous lighting. In this he specifically bears on the necessity of passing the current through it in opposite directions, obviously for the purpose of roughening, that is to say, 'disintegrating' the surface of the lead. I would also refer Mr. Sellon to Mr. Faure's patent of the 16th April, 1881, in which the following passage occurs, '. . . . constructed upon what is known as the Planté system in which the . . . . surface is produced by disintegration of the substance of the plate itself.' Now had Mr. Sellon chosen to cite both Mr. Planté's patents instead of only the one subsequent to his own, it would have been seen how impossible it is for him to broadly claim the *roughening of plates*, and thus preclude Messrs. Parker and Elwell from making a specific claim, and this is the gist of the whole discussion. I was not aware when I commenced this correspondence that Mr. Planté had ever taken a patent in England, and merely acted on the knowledge I possessed of the general principles of his battery as made public prior to Mr. Sellon's patent of 10th September, 1881."

Erratum.—In line 17 of Mr. Reckenzaun's letter on "Secondary Batteries" on p. 41 of our last week's issue, instead of "37 ampère hours" it should read "57 ampère hours."

Professor Tyndall and his Audience. — Professor Tyndall having at the last of his lectures to juveniles on "The Sources of Electricity," presented a copy of his "Notes on Electrical Phenomena and Theories" to all who attended, he was, as soon as he had finished speaking, besieged by an eager throng of boys, who besought him to write his name in the books. This he consented to do, and was engaged for a long time after the bulk of the audience had dispersed in complying with the lads' wishes.

The Gas Undertakings of the United Kingdom.—Returns relating to all authorised gas undertakings in the United Kingdom, including those belonging to local authorities and those not under the control of such authorities, were issued on Wednesday. Under the first category the total amount of gas consumed amounts to 22,308,058,516 cubic feet, and in the case of undertakings other than those belonging to the local authorities the total number of cubic feet of gas sold was 47,808,265,546.

The Consolidated Electric Company, Limited.—This company has issued a list of reduced prices for its secondary batteries, which are on the B.T.K. system, as used at Colchester.

Overhead Wires in America.—Mr. David Brooks has written upon this subject to the Mayor of Philadelphia as follows :—" Not long since all parties and companies operating overhead wires appeared before the Electrical Committee of Councils to give their reasons why they had done nothing in compliance with the ordinance of Councils of June 13th, 1882. An ordinance extending the time one year for laying the wires has been rushed through the Select Council. With over two years given the telegraph and telephone companies to put down their wires, not one foot of wire have they placed beneath the surface, but have been exceedingly busy erecting new poles and stringing additional wires. By their own statements the Bell Telephone Company had one year since 1,300 miles of overhead wires, and now, when there is less chance of their being obliged to pay taxes on them, they give the number of miles over 3,000. They say there is no practical mode of placing wires underground, or if they should use any known system it would make the service so expensive that no one could afford to use it. A mile of telephone wire, such as the Bell Telephone Company uses, a No. 14 galvanised steel, costs about $4.40 per mile. Over half of their subscribers are within less than half a mile of Fourth and Chestnut Streets—their exchange ; consequently the wire employed to reach those subscribers costs less than two dollars and a half. For the use of this wire they charge their customers $60 per annum and $60 for the use of two telephones, although in most cases one telephone at the exchange is made to answer for 20 or more subscribers. If the wire does not extend over 100 feet to reach the subscriber, still the charge for wire is $60 per annum. The telephones do not cost over $10, and an actual outlay of $15 is made to bring in a rental of $120 per annum. In London the Government pays $75 per mile for the wire insulated from end to end with gutta percha. They use twice the length of wire, forming a metallic circuit, to overcome induction, and placed underground. They give them far better telephones, and with this outlay of, say, $175, they charge their customers £14 10s., or about $70 per annum. In Paris they give a similar service to the London service at a charge of $60 per annum. The Bell Telephone Company object to paying city taxes (but they have plenty of money for other purposes). The same arguments that have been used in select councils can be repeated successfully a year hence. The object of the bill is to fetter and tie the hands of the mayor in the discharge of a police duty. They have represented that the mayor would cut down every pole in the city on the 1st day of January, and use no discretion. No one wishes him to do that, but if the ordinance of June 13th, 1882, remains unrepealed the mayor can use his judgment in such way as to bring the least inconvenience to the citizens of Philadelphia, and at the same time to bring a monopoly to its senses. A similar ordinance, extending time, was passed by the Councils of Chicago, but the mayor vetoed it, and received the thanks of the community."

The Union Electric Light and Power Company, Limited.—At Bow Street Police Court, last week, a number of summonses were heard against this company and Messrs. Alfred Parrish, Dilwyn Parrish, and John Goddard, as directors, for neglecting to forward a list of members and a summary of shares to the Registrar of joint stock companies. The alleged irregularity was with reference to the return of calls for the year 1883, which had been represented as £25,700, whereas it was alleged that 59 £100 shares had been issued at the time for which no money had been paid. Thus the return represented £5,900 more than had been actually paid. Sir James Ingham thought the Act had not been throughly complied with, but considered that it was a slip through carelessness, for the register of the company had been kept in the most proper and concise manner possible. He imposed a nominal fine of £3, and with regard to the summonses against the directors for permitting the default, he considered that the evidence did not support the allegation, and therefore dismissed the summonses.

The Cholera and Electricity.—A visitor to a cholera hospital of Paris was told by the physician in charge that he had been trying both continuous currents of electricity and ice, and that the former had done good work. The employment of electricity in such cases is by no means new, for in a book by the late Mr. Alfred Smee, F.R.S., entitled "Elements of Electro-Biology," and printed in 1849, the writer mentions that the alimentary canal is very easily affected by a current of electricity, and continues: "I have heard that electricity has been advantageously employed at the Free Hospital to rally a patient in the collapsed stage of cholera—a fact which I mention here, as this disease involves to a great extent the functions of the alimentary canal."

Primary Batteries.—Several new primary batteries are in the field, and there are more to come. An iron cell, invented by Dr. Pabst, of Stettin, is finding great favour in Germany. Its electrodes are carbon and wrought iron dipping into a solution of ferric chloride. It is practically unpolarisable and self-regenerating. It works at the expense of iron and of the oxygen of the air, which is absorbed into the liquid, whilst ferric oxide is deposited at the bottom of the cell. Its electromotive force is about ·78 of a volt. The Pabst cell ought to prove of value for domestic electric lighting, as its internal resistance is low and its constancy remarkable.

Another Jablochkoff Battery.—M. Jablochkoff announces another battery of great scientific interest. A small rod of sodium weighing about 8 grammes is squeezed into contact with an amalgamated copper wire and flattened. It is wrapped in tissue paper and then damped with three wooden pegs against a plate of very porous carbon. This completes the element. The moisture of the air settles on the oxidised surface of the sodium. It works without any other liquid. The E.M.F. is 2·5 volts, but the resistance is as great as 25 ohms.

International Inventions Exhibition.—The Council of the Society of Arts announce that they will award the following gold medals in connection with the International Inventions Exhibition. Under the Howard Trust, five gold medals for the best exhibits (coming within the terms of the Trust) in the following classes:—One for the best exhibit in Group iv., "Prime movers," Class 26—steam engines and boilers; one for the best exhibit in Group iv., Class 27—gas and air engines; one for the best exhibit in Group iv., Class 28—means of utilising natural forces; one for the best exhibit in Group xi., "Hydraulic machines, &c.," Classes 59 to 62; one for the best exhibit in Group xiii., "Electricity," Class 72—distribution and utilisation of power. The council propose to ask the juries in each class to recommend for their consideration either two or three exhibits which they might consider deserving a prize. It will not be necessary for any special application to be made in respect of these prizes. The medals are each of the value of £20.

Blackpool Electric Tramway Company, Limited.—This company has been formed for the purpose of constructing and working an electric tramway upon Mr. M. Holroyd Smith's patents at Blackpool. The line is to extend from Claremont Park to the end of the South Shore, along the Promenade. According to the prospectus, arrangements have been made with the Blackpool Corporation to lay the ordinary tramway lines and grant a lease to the company upon favourable terms for seven years, with right of renewal. The company will thus be relieved from the heavy expense of constructing the lines, and will only have to provide the electrical plant and equipment. The capital is £30,000, to be divided into 3,000 shares of £10 each. The directors are inviting tenders for the engines and boilers required in carrying out the work. The company reserves the right to make use of horse-power if necessary.

Theft of Telephones.—Joseph Laurence Connell, late assistant foreman at the torpedo and telegraph stores at the Royal dockyard, Woolwich, and Sergeant Henry J. Bastick, of the Indian Ordnance Department, have been brought up and remanded at Woolwich on a charge of stealing Government property, including telephone receivers, to a considerable value. Bastick was arrested upon landing in India, and the stolen property was found among his baggage.

An Electric Governor.—The *Industrial World* of December 4th says: "A feature in electric lighting has been on exhibition at the Globe Iron Works of H. A. Streeter, Chicago, during the week, consisting of an electric governor which regulates the motive power of the engine generating the electric current. By means of this device, when by chance or design a portion of the electric lights are turned out or additional light turned on, the admission of steam, and consequently the power of the engine, is regulated so as to be just sufficient to keep the lamps still burning and prevent the production of excessive electricity and the consequent danger from fire. The inventor is Mr. Amet."

New Submarine Boat.—Trial trips have recently been made at Nice with a submarine boat, designed by Toselli, which will probably be of great service to this naturalist. The boat can penetrate to a depth of about 250 metres, and as it is surrounded by powerful electric lamps, it is possible to subject the sea to a minute inspection. The vessel has the form of a cylinder, is built of iron, and is let down into the sea from a larger vessel, water ballast and lead drawing it down. In the bottom and sides, glass windows are fixed. Besides the chains, which fasten it to the vessel, it is connected with the same by telephone. M. Toselli intends building a still stronger boat, by means of which he hopes to penetrate to a depth of a thousand metres, which no human eye has ever yet been able to see.

Petroleum Magnetic.—It is now claimed, says the *Philadelphia Record*, that refined petroleum in tin cases exerts an influence on the compasses of a vessel equal to the same amount of iron or steel. The masters of the German ship *J. Weisselholm* and the schooner *Maggie Dalling* have made written reports confirming the above, and in the latter case the captain claims that his vessel went ashore through an error caused by cased petroleum. How many people when they speak of a tin case know that the so-called tin is actually iron tinned over? Our contemporary even seems not to have noticed the fact.

The Electromotive Force of Batteries.—A note by M. Chaperon, recently presented to the French Academy of Sciences, is designed to throw some light upon this question. A cell consisting of aluminium, dilute sulphuric acid, sulphate of copper, copper, gives 0·62 volts, whereas the theoretic value is 2·06 volts. In the same way a magnesium-platinum couple in potash, contrary to the theory, is less energetic than a zinc platinum couple in the same liquid, and gives 1·35 volts instead of 1·43 volts. Polarisation is commonly believed to be a cause of this discrepancy, and M. Chaperon has made some interesting researches on the subject. His method was to obtain curves of the electromotive force of a cell by charging a condenser from it at intervals by means of a rapid working key. The curves show that the metals studied give, with the electrolytes in which they were examined, polarisable systems until the decomposition of the electrolyte into its elements, the difference of potential retained by the electrodes growing, after a continuous law, between zero and the point of electrolysis, and even beyond it. The limit of electromotive force thus obtained after apparent electrolysis is often superior to that given by platinum. Thus with magnesium in the alkalies the electromotive force restored was 3·8 volts; with aluminium in acidulated water it was over 4 volts.

Underground Haulage by Electricity in a German Colliery.—At a recent meeting of the Mining Institute of Scotland, a paper was read by Mr. Robert Thomas Moore, C.E., B.Sc., entitled "Notes on some Saxon Collieries." One of the mines visited by the author during the past autumn was the Zaukeroda Colliery at Plauen, near Dresden, which belongs to the Government. As a special feature of the appliances in use at this colliery the author remarked that there is one of Siemens and Halske's electrical locomotives drawing coals along one of the underground roadways over a distance of some 700 yards. Driven by belting from a small vertical engine, having its cylinder inverted and with its pulleys about three to one, there is on the surface the primary dynamo machinery, which is run at about 600 revolutions per minute, while the engine has a speed of about 200 revolutions per minute. The current from the dynamo is carried down the pit shaft, which is about 120 fathoms deep, by means of $\frac{1}{4}$-in. copper rods, and along the level roadway it is conveyed by means of two rails of T-section which are fastened to the roof of the mine. The road, which is a crosscut mine for getting over a fault, is laid with a double line of rails, and is arched with brick throughout its whole extent. Porcelain insulators are fixed in the brickwork for carrying the conductors. There is a secondary dynamo on the locomotive, which is connected to the wheels of the latter by means of gearing. Each pole of the dynamo communicates with one of the conductors on the roof by means of a covered wire, one end of which is fastened to a carriage running on the rail, and the other to a pole of the dynamo. The "race" consisted of 15 tubs, each containing 10 cwt., and when loaded weighing 15 cwt. The locomotive was put behind the "race" and ran the whole length of the drift in four minutes, or at the rate of about seven miles an hour. It was making 25 runs per day, and drawing about 200 tons in that period. Mr. Moore learned that the following was the proportion of useful effect of the arrangement. Steam engine 10-horse power, and the dynamo and locomotive, respectively, 5 and 3-horse power, from which it was concluded that 30 per cent. of the power of the steam engine was got out of the locomotive. The cost of the whole erection at the colliery was about £900, and the system has been in operation for nearly two years, the engine working very satisfactorily, giving no trouble, and the working expenses being very low. As the cost of repairs was almost *nil*, the chief expenses consisted of the wages of the enginemen on the surface and on the locomotive.

The Electric Light in a Colour Factory.—We learn from *La Lumière Electrique* that an installation of incandescence lamps has just been erected in the colour manufactory of MM. Sordes and Huillard at Suresnes. This firm has replaced 80 gas jets in its establishment by electric lights. The installation consists of about 130 lamps fed by an Edison dynamo, which gives a current of 90 ampères and 110 volts at 1,050 revolutions. The machine absorbs, in full work, 16 horse-power; it is driven by one of the engines on the premises, and is placed, together with the switch board, in a building to which access is not allowed to the workmen. The system of conductors is extensive, the extreme points being 140 metres apart. The lamps which light the tank or vats filled with steam, are furnished with holders paraffined to resist the moisture; the other lamps, mounted on ordinary holders, are distributed in the yards and offices. The houses of MM. Sordes and Huillard, which are near to the works, have special circuits; the lamps are fitted in all the floors. As the dynamo runs all night the lamps can be set in action at any hour. The cost of the new lighting does not exceed 7,930 francs (£317), including amortisation and interest on plant, while gas cost 11,800 francs (£472) last year.

A Queer Atlantic Lightship.—A correspondent —of whose sanity we do not feel certain—writes to the *Liverpool Daily Post*:—I am of opinion that a lightship and a telegraph station might be moored and laid midway between here and Boston on the great watery highway on which the ships of all nations are daily sailing or steaming, and that the lightship and postal station might be put in communication with the whole civilised world by means of the electric cable, immediately over which, I assume, the lightship should be anchored. The anchoring, I admit, would be the difficulty. Divers could get at the cable, and effect a communication with it. But might not the weight of the strong and necessarily heavy chain to which the lightship should be moored be buoyed all along its length, to keep it light in the water and on the ship? What say our nautical engineers and scientific seamen? How it would gladden the hearts of thousands to hear the news from this lightship that the crew of a disabled steamer or a waterlogged timber ship had "put in," and got all the crew safe on board the lightship. I assume that any nautical man—I mean captain or mate—could find the lightship in the daytime, and that an electric light, seen at a distance of 40 miles, would guide him to it at night. But what say our nautical scientists?

Personal.—Messrs. Woodhouse and Rawson have appointed Mr. I. C. Peache, late assistant to the manager of the locomotive department, London and North Western Railway Works, Crewe, as manager of their works at Cadby Hall, Hammersmith Road, W.

NEW COMPANY REGISTERED.

Sir Coutts Lindsay and Company, Limited.—Capital £7,000 in £1 shares. Objects: To carry on the business of an electric company in all branches. Signatories: Sir Coutts Lindsay, Bart., Balcarres, Fife, N.B., 4,000 shares; Nugent Charles Wade, secretary of the Clergy Club, 135, New Bond Street; Arthur Fenwick Wade, Athenæum Club; Regd. Brougham, C.E., 15, Great George Street; J. K. D. Mackenzie, C.E., 15, Great George Street, S.W.; A. C. Curtis Hayward, 27, Chancery Lane; G. E. Wade, 9, Albert Mansions. The last six signatories subscribe for one share each. Registered 12th inst., without articles of association, by Mr. A. C. Curtis Hayward.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

New Telephone Company, Limited.—At an extraordinary meeting of the shareholders in this company, held at the offices, 39, Lombard Street, on the 18th ult., it was resolved that various alterations should be made in the articles of association, to the effect that every member should have one vote for every £5 of nominal capital held up to £2,500 and one vote for every £50 beyond that amount; it was also resolved that the profits available for dividend should be divided only upon so much capital as shall be deemed paid up. In the event of the company winding up, the surplus assets are to be divided as follows:—1st. In paying back any capital called up in the winding up. 2nd. What remains is to be distributed amongst the members *pari passu* in proportion to the remaining paid up capital, but so that only so much capital per share shall be deemed paid up on the vendors' shares as shall be equal to the average amount paid up on the other shares. 3rd. The residue to belong to the members in proportion to the nominal capital held by them respectively. These resolutions were confirmed on the 2nd inst. and filed on the 12th inst.

Railway Electrical Contractors, Limited.—The first return of this company, made up to the 31st ult., was filed on the 12th inst. The nominal capital is £25,000 in £5 shares. The number of shares taken up is 4,250 upon which the full amount has been called up. The calls paid amount to £20,822 13s. 11d., and unpaid to £427 6s. 1d. Registered office, 4, Great Winchester Street, E.C.

National Company for the Distribution of Electricity by Secondary Generators, Limited. — The second return of this company, made up to the 29th ult., was filed on the 10th inst. The nominal capital is £500,000 in £10 shares. The number of shares taken up is 1,818 preferred and 20,000 ordinary, upon each of which the full amount has been called up, the calls paid amounting to £218,150, leaving £30 unpaid. Since the date of the previous return 21,091 shares have been taken up and the paid up capital has increased £211,520. Registered office, 18, Warwick Street, Regent Street.

Jablochkoff Electric Light and Power Company, Limited.—The liquidator of this company has notified the Registrar of Joint Stock Companies that under the provisions of the Companies' Act, 1862, section 20, the company testifies its consent to the registration of the new company entitled the Jablochkoff and General Electricity Company, Limited.

CITY NOTES, REPORTS, MEETINGS, &c.

The Western and Brazilian Telegraph Company, Limited.

THE report of the directors for the year ended 30th September is as under :—

The total earnings amount to £106,174 8s. 4d., a decrease of £6,532 2s. 8d. compared with last year, caused by the interruption of the Brazilian Submarine Company's cable.

The working expenses for the year, exclusive of renewals of cable, amount to £61,871 5s. 2d. as against £61,127 19s. 11d., an increase of £743 5s. 3d. These expenses include £1,129 14s. 6d. for depreciation of ss. *Viking*, an item which did not enter into last year's accounts.

Including the amount brought forward from last year, the balance to the credit of the revenue account is £18,757 8s. 9d., from which, for the reasons given hereafter, the directors regret they cannot recommend a payment of a dividend.

In consequence of the interruption of the Brazilian Submarine Telegraph Company's cable between St. Vincent and Pernambuco, referred to in the last report, and of a second interruption of the same section from the 2nd to 28th March, 1884, the revenue of the company derived from international messages was almost entirely wanting for no less a period than 101 days. The duplication of the cables of the Brazilian Submarine Telegraph Company, which has since been effected, will in all probability prevent the recurrence of such a serious loss to the revenue of this company.

The company has had to replace by sheathed cable during last year 382 miles of the old unsuitable type of cable; the amount thus expended, £36,622 12s. 1d., has been charged to the renewal fund. On the other hand, the directors have credited the same fund with £15,000, part balance from revenue account, absorbing the amount which otherwise would have been available for dividend.

Attention has been repeatedly drawn to the reasons which necessitate the employment of two steamers, and the gradual removal of the old strand type of cable. The greater portion of this type has now been replaced by sheathed cable, and such lengths as still remain will be dealt with in the same manner. Until the company's system consists of sheathed cable from end to end, the directors must provide against interruptions in the strand cable, which should never have been laid in the first instance, and the interruptions in which have been the source of constant difficulty.

The mileage of the strand type has been reduced from 2,500 to 450 miles, and the directors consequently hope to make arrangements in reference to the repairing ships, which will shortly reduce the heavy outlay now necessary. The company would have suffered to a much more considerable extent from competition, had they not been in a position to effect speedy repairs with these vessels.

Notwithstanding the reduction in tariff made by the Company last year, the revenue shows a very satisfactory growth, and the board think it right to state that the revenue for the first quarter of the current financial year not only shows that the loss of last year has been recouped, but that the traffic is in excess of any previous year. The general position of the company, financially and otherwise, shows decided improvement.

The Maxim-Weston Electric Company.—Mr. Hugh Watt, chairman of this company, states, in reply to numerous inquiries as to dividend, that the financial year of the company does not end till March 31st, and that the company's business has been rapidly increasing in spite of dull trade during the last month, important Government, home, and shipping contracts having been secured, "which, with others well advanced, should leave a fair surplus, and enable the board in April next to make a return to the shareholders of an Electric Company, Limited, for the first time since the 'electric fever' era of some years ago."

Jablochkoff and General Electricity Company, Limited.—As announced last week, this is the name of a new corporation formed to take over the patents and business of the late Jablochkoff Electric Light and Power Company, Limited. Sufficient capital has been subscribed privately, and the purchase contract has been confirmed by the Court of Chancery. Mr. Francis R. Reeves has been appointed secretary and manager of the new company, the registered offices and works being at 36, Albert Embankment, Lambeth, S.E.

The Cuba Submarine Telegraph Company, Limited.—The directors have resolved, after providing for the dividend on the preference shares and placing £550 to the reserve fund, to recommend the payment of a dividend on the ordinary shares at the rate of 7 per cent. per annum, free of income tax, leaving £440 to be carried forward to the current half-year's account.

Great Western Electric Light and Power Company, Limited.—The liquidators of this company are Messrs. Emile Garcke and F. W. Reynolds, of 4, Great Winchester Street, E.C., to whom creditors are required to furnish particulars of their claims on or before February 26th.

Brush Midland Electric Light and Power Company, Limited and Reduced.—Creditors are required to communicate with the liquidator, Mr. Emile Garcke, 4, Great Winchester Street, E.C., on or before February 26th.

Pilsen-Joel and General Electric Light Company, Limited.—A petition for the confirmation of the reduction of the capital from £200,000 to £84,400 is to heard before Mr. Justice Pearson on the 24th inst.

The German Union Telegraph and Trust Company, Limited.—The directors have decided to pay an interim dividend of 5s. 9d. per share, free of income tax, on the 20th inst.

NEW PATENTS—1885.

31. "Connections for incandescent lamps." R. A. LEE. Dated January 1.

32. "Galvanic batteries." J. E. CHASTER, R. A. LEE. Dated January 1.

48. "Galvanic or primary batteries." C. MALTBY-NEWTON. Dated January 1.

53. "Method of railway signalling by automatic electric lanterns or semaphores." H. J. GARDNER. (Communicated by C. D. Tisdale.) Dated January 1.

74. "Dynamo-electric machine." W. H. BECK. (Communicated by H. Cadisch.) Dated January 2.

75. "Holder and switch combined for incandescent electric lamps." A. GRUNDY. Dated January 2.

137. "Process of electrolysis and apparatus for the same." S. PITT. (Communicated by J. A. A. FILLOD.) Dated January 3.

141. "Exhausting apparatus applicable in the manufacture of incandescent lamps." M. EVANS.

154. "Electric telegraphs." A. MUIRHEAD. Dated Jauuary 5.

165. "Apparatus for regulating or measuring electric currents." J. V. JONES. Dated January 5.

167. "Utilisation and generation of bye products of galvanic batteries." J. RAPIEFF. Dated April 4, 1884.

185. "Producing electricity and apparatus therefor." S. MOND. Dated January 6.

186. "Means for opening or closing an electric circuit." H. WILKINSON. (Communicated by J. G. W. Fairbairn.) Dated January 6. (*Complete.*)

188. "Combined holder and reflector for incandescent electric lamps." E. C. TOLLER. Dated January 6.

252. "Method of constructing, operating, regulating, and controlling electrical machines, or the electrical circuits thereof, for the development or utilisation of electric force, and apparatus or means employed therefor or therewith." J. S. WILLIAMS. Dated January 7.

253. "Method of constructing, operating, regulating, and controlling electrical machines, or the electrical circuits thereof, for the development or utilisation of electric force, and apparatus or means employed therefor or therewith." J. S. WILLIAMS. Dated January 7.

254. "Method of constructing, operating, regulating, and controlling electrical machines, or the electrical circuits thereof, for the development or utilisation of electric force, and apparatus or means employed therefor or therewith." J. S. Williams. Dated January 7.

269. "Machines for diminishing their mechanical friction by means of electro-magnets, more especially adapted for electro-magnetic motors)." E. Toynbee, J. R. Culley. Dated January 8.

276. "Telephonic apparatus." A. P. Price. Dated January 8.

282. "Electric telegraphy and transmitting and receiving apparatus for working long lines." A. M. Clark. (Communicated by L. Maiche.) Dated January 8.

311. "Electric telegraphic apparatus for transmitting and receiving signals on board ship or other places." J. S. Gisborne. Dated January 9.

354. "Combined magnets and coils to be acted on by currents or signals in electric telegraph apparatus." J. Scotland. Dated January 10.

376. "Electric annunciator." F. Walker. Dated January 10.

455. "Printing telegraph." G. M. Hathaway. Dated January 13. (*Complete.*)

457. "Generation or production of electricity and apparatus therefor." G. F. Redfern. (Communicated by A. Bernstein.) Dated January 13.

484. "Method or means and apparatus for developing, distributing, regulating, varying or utilising the transformation of matter or force in an electric circuit or a system of electric circuits." J. S. Williams. Dated January 13.

485. "Electrical accumulators or batteries and method or means of constructing same or parts thereof, and apparatus or means employed therefor or therewith." J. S. Williams. Dated January 13.

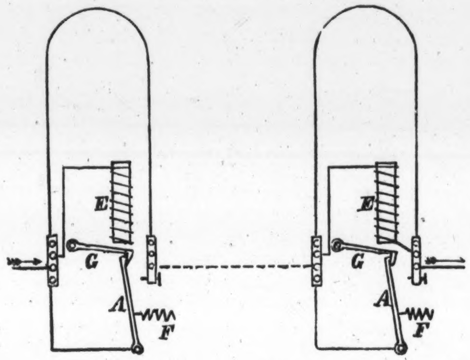
487. "Method of and appliances for maintaining direct electrical communication between the shore and any vessel or floating object by means of a telegraph cable having an unbroken insulated electrical conductor and for preventing the twisting or kinking of such cable." F. Le B. Bedwell. Dated January 13.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1884.

1100. "Improvements in primo-secondary batteries, or batteries which partake of the nature of primary and secondary batteries." G. G. André. Dated January 9. 6d. The inventor makes the negative element with a wooden core with bottom flange, and with sheet lead or wire wrapped round the core and surrounded with highly burnt powdered or granulated coke mixed with peroxide of lead, all enclosed in a porous envelope, which may be made of two layers of canvas. The canvas may in some cases be nitrated to make it acid proof. One or more such elements are placed in the solution containing the positive element, which may be zinc, iron, or lead. When the peroxide has been reduced to protoxide the negative element is removed, sent to the charging station, and there, by the action of the current from a dynamo machine, the protoxide is again reconverted into peroxide, thus rendering the negative element ready for use again. The exciting liquid may also, if desired, at longer intervals when zinc is used for the positive element, be removed to the charging station, and the zinc be deposited by the same charging current.

1108. "Improvements in and relating to apparatus for telephone exchange systems." W. R. Lake. (Communicated from abroad by J. W. Duxbury and H. W. Breckenridge, both of America.) Dated January 9. 6d. That part of this invention which relates to telephone exchanges consists in connecting all the lines entering the exchange with each switch board; in separating the working attachments of the subscribers' lines into groups on the several switch boards, and in providing the lines which enter the exchange with a relay, and in so connecting the relay that any operator can connect with any line. That part of this invention which relates to the switch board consists in the peculiar and novel construction of the board, which is formed of strips differing in colour, and has a series of wires which cross each other at right angles; and in the peculiar construction of the key, by means of which a metallic connection is made and broken between any two of the wires.

11617. "Improvements in apparatus for short circuiting incandescence lamps arranged in series." C. D. Abel. (Communicated from abroad by the firm of Siemens and Halske, of Germany.) Dated August 25. 6d. In arranging incandescence lamps in series on a conductor it is necessary to provide means by which, when one of the lamps ceases to act, the current is caused automatically to pass uninterruptedly through the other lamps so that their action may not be interfered with, the lamps being thus rendered independent of each other. This is effected according to the present invention by providing each lamp with a bye-pass or shunt circuit of high resistance, through which a small portion of the current is consequently always passing when the lamp is in action, but instead of causing the entire current to pass through the shunt circuit to the other lamps when the lamp cease sto act, which would be objectionable on various grounds, a small increase of the current passing through the same is made to effect the closing of the contact arrangement of a second shunt circuit of low resistance through which the current then passes. The fig. shows a diagram of one arrangement for this purpose. The shunt circuit of high resistance constitutes a solenoid or electromagnet, E, which, when only excited by the quantity of the current passing through it, when the lamp is in action, is not strong enough to actuate the hook-shaped armature, G, which holds the contact lever, A, of the second shunt circuit of low resistance out of contact, but when in consequence of the decrease or interruption of the current passing through the carbon filament the current through E is increased, the hook-shaped armature, G, is attracted, and in thereby releasing the contact lever, A, allows this to be acted upon by a spring, F, so as to close the contact of the shunt circuit of low resistance through which the current will now pass on to the other lamps, only a very small portion of the same continuing to pass through E.

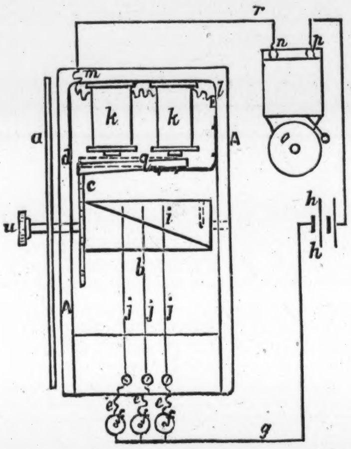


1157. "Improvements in induction coils." J. Swinburne. Dated January 10. 2d. In an induction coil, according to this invention, wherein an alternating current is to be used in the primary coil, the inventor dispenses with the iron core heretofore usually employed, and mixes the wires of the primary and secondary coils together. Thus a coil or bundle of cable of two or more strands may be used, some of the strands being employed for the primary circuit and others for the secondary, there being no magnetic core. For direct currents the same arrangement may be employed with or without a magnetic core, but the inventor makes the current either intermittent in the primary circuit, or alternating by the use of a circuit breaker or commutator. This may be, for instance, a commutator driven by a small motor, whose speed is governed by the electromotive force on the terminals of the secondary circuit, so that, for instance, several of these machines may be placed in series, each feeding a varying number of incandescent lamps, preserving uniform electromotive force on their terminals, and absorbing power in proportion to the number of lamps used, in spite of variations of electromotive force or current available in primary circuit.

1178. "Improvement in the manufacture of incandescent electric lamps, or glow lamps." J. Swinburne. Dated January 10. 4d. A touching contact is made of the carbon filament end and the leading-in wire. Then the juxtaposed ends of the filament and leading-in wire are locally heated by current or otherwise in the presence of a carbonaceous vapour or liquid. In this way the inventor can make a butt, or a lap, or a cross joint. The carbon filament may be first attached by a suitable cement such as moistened black lead, and the junction be afterwards locally heated. The carbon filament may be joined to iron, nickel, gold, or cobalt, or any conductor that will stand the heat. A small carbon sleeve may be used to attach the carbon and make contact to start with. When a tubular carbon is used its hollow end may be slipped over the leading-in wire.

1271. "Improvements in the generation or production of electricity by voltaic action and apparatus therefor." E. P. Chaimsonovitz. Dated January 11. 6d. Relates to the production or generation of electricity by the employment of a number of positive and negative electrodes or elements mounted on a shaft and revolving in the exciting fluid of a galvanic battery, the said electrodes being suitably connected with a commutator or commutators so as to produce an alternating or continuous current. By this arrangement the inventor is enabled to utilise with advantage the maximum surface of the electrodes and to produce electricity in great quantity at a minimum of expense.

1369. "Improvements in electric signalling apparatus." T. R. Brailsford. Dated January 12. 6d. Relates chiefly to electric signalling apparatus in which on an electric bell being rung from one or other of a number of rooms or places an indicator is at the same time moved to indicate from which room or place the bell has been rung. But the improvements are also applicable to other signalling apparatus. *a* is the disc on which are marked the indications to be given, and *b* is the axis or drum on which the disc, *a*, is mounted, the said axis working in a suitable frame, A; *c*, is a notched disc on which bears the detent, *d*, on the removal of which the disc, *a*, is caused to revolve (by a weight or spring not shown in the drawing) until the required indication is brought into view by a corresponding part of the disc, *a*, appearing through a perforation in the case of the apparatus or at any other desired mark. *e, e, e,* are the insulated wires leading from each room to the part of the building where the apparatus is to be placed as usual; *f, f, f,* are the usual contact makers or apparatus in each room or place, and by which contact makers the wires, *e, e, e,* can be coupled to the main wire, *g*, from one pole of the battery, *h*; *i*, is the metal plate which surrounds the drum or axis, *b*, of the disc, *a*, and *j, j, j,* are the spring contact makers which press upon the plate, *i*, and are connected to the wires, *e, e, e,* the ends of which are led into the apparatus from each room; *k*, is the electro magnet with one end, *l*, of the coils of which the metal plate, *i*, is in contact through a screw (shown in dotted lines) and the frame, A; the other end, *m*, of the coil of the electro magnet, *k*, is coupled with one end, *n*, of the magnet of the electric bell, *o*; the other end, *p*, of the bell coil being coupled up with the other pole of the battery. The operation of the improved apparatus is as follows:—When contact is made in any particular room or place by the usual means such as by pressing on the push pieces, *f*, the current will pass through the main wire, *g*, to the corresponding terminal spring, *j*, contained in the apparatus, thence through the metal plate, *i*, or its equivalent, through the screw (shown in dotted lines), the frame, A, and through the coils of the electro magnet, *k*, and thence by the wire, *r*, through the bell, *o*, to the other pole of the battery, *h*, the magnet will attract an armature, *q*, attached to the detent, *d*, or its equivalent, which being so attracted will release the notched disc, *c*, and allow the disc, *a*, and drum, *b*, to revolve under the action of the spring or weight so long as the current is passing through the coils of the magnet. The distance the disc, *a*, and drum, *b*, are allowed to revolve so as to bring into view the required signal is determined as follows:—The plate, *i*, on the axis or drum, *b*, of the disc, *a*, on which plate all the terminal springs press is as hereinbefore described of the form of a right angled triangle as shown (or other suitable shape) and upon one edge of the plate, *i*, all the terminal springs, *j, j, j,* press when the disc, *a*, is at zero. The current flowing through any one of the springs, *j*, on to the plate, *i*, will therefore be of a proportionate duration with the length of time such spring, *j*, remains in contact with such plate, *i*, ceasing as the end of the spring breaks contact from the edge of the said plate as it revolves. In this manner the moment the metal plate, *i*, on the drum or axis, *b*, of the disc, *a*, breaks contact with the spring, *j*, through which the current is flowing, the detent, *d*, held by the electro magnet, *k*, will be released and cause the disc, *a*, to stop revolving and thereby show the required indication, at the same time causing the bell, *o*, to ring so long as contact exists between the springs, *j*, and the plate, *i*, by reason of its being included in the same circuit as that of the indicating apparatus. The signal having been given in the manner above described, the disc, *a*, and drum, *b*, are, when the signal is being attended to, replaced ready for another signal, by turning the same round to zero in the reverse direction to that in which the disc and drum are caused to rotate by the action of the weight or spring. This is effected by turning a knob or button, *u*, in front of the disc, *a*, as shown in the drawing, or by means of a pendant cord.



1721. "An improvement in protectors for the insulators of aerial telegraph wires." B. Pell. Dated January 18. 4d. The inventor protects the insulator by a metal cup or case, open at the top, and attached at its base to the support of the insulator, preferably by the same stem as that which carries the insulator itself. This cup or case extends up from the point of attachment in cylindrical or conoidal form around the insulator, but at some distance from it, so as to leave an annular space between it and the insulator.

1786. "Improvements in microphone transmitters for telephonic purposes." W. R. Lake. (Communicated from abroad by J. Berliner, of Hanover.) Dated January 19. 6d. The inventor employs two or more microphonic contacts in such a manner that the electric current from a battery or other source of electricity will pass through all of the said contacts simultaneously. It is preferred to arrange these contacts in combination with a single diaphragm, that is to say, to fix one half or part of each of the said contacts to the said diaphragm. The other halves or parts of the said contacts are suspended like a series of pendulums from a bent arm or piece fixed to the box or casing of the instrument. These pendulum contact pieces may be of equal length or of different lengths, and of equal or different weight. The diaphragm employed is fixed to the frame at only one point of its circumference, and is, in some cases, suspended like a pendulum, and may or may not be adjustable by means of a set screw. One or more springs are fixed to the frame, and arranged to bear upon the diaphragm to regulate its vibration; these springs are sometimes provided with an adjusting screw. The apparatus above described may be combined with one or more induction coils and condensers.

CORRESPONDENCE.

Secondary Batteries.

We must really apologise for once more intruding on your space, but we cannot let the statements made by Mr. Sellon and Mr. Reckenzaun last week pass unnoticed.

To cut short the question as to the capabilities of the old form of our stationary cell, we will undertake to show that those very same plates from which Mr. Reckenzaun obtained the poor results given, if treated according to our directions, will show a *useful* capacity of at least 80 ampère-hours, and require only 88 ampère-hours charge. These cells were among the earliest we made (in 1882, or early part of 1883), and, in spite of the information obtained by Mr. Sellon, we believe they had remained dry many weeks and become thickly coated with carbonate of lead, which would temporarily disable them.

We discontinued the construction of these cells about a year ago, because we found that it was necessary to make secondary batteries that could be used without either care or experience by any ordinary householder, and by modifying that type we arrived at the form of the small circular cells which Mr. Reckenzaun saw at the Healtheries, and took for the older type. These round cells are designed without regard to weight or bulk, but *with* regard to simplicity, certainty of action, and great durability. Also they are the cheapest form that can be devised.

But the battery which lighted about 50 lamps (20 c.p.) in four of Mr. Tayler Smith's rooms at the Healtheries—the gas engines, regulated by the small round cells, lighting the other four rooms on a separate circuit—consisted of 25 rectangular cells, each containing 12 plates 17 in. by 11 in., weighing in all 110 lbs. per cell, and was of the strong stationary kind. This battery easily maintained, *in regular practice*, the 50 lamps for six or seven hours, and, in case of need, would keep all the 100 lamps going without injury. The rate of charge was 30 to 50 ampères, and the efficiency shown was at least 75 per cent, and, of course, with a lower rate of charge it would be much higher. Similar batteries to this have lately been giving 400 to 500 ampère-hours useful discharge.

But, whilst we are upon the subject of the Healtheries battery, permit us to reply, *seriatim*, to Mr. Sellon's hastily written remarks.

1. *Improved condition.*—If Mr. Sellon will turn to the "Recherches sur l'Electricité," page 37, par. 39, "Couples secondaires à lame de plomb parallèles," he will find that his cell is "a close imitation" of a form devised by Planté in 1868. If the Sellon cell be copied by Elwell and Parker, then the Sellon must have its plates suspended, so that they do not touch the bottom of the cell and risk short circuiting. Also the Sellon plates would, in that case, be full of perforations to assist the circulation of the acid, and indentations to to prevent the folds of the plate closing upon each other and preventing the circulation of the acid between them. Has the Sellon all these points?

We may add that, so far from our having imitated Mr. Sellon's arrangement, we have the best reason to suppose he has imitated ours, as he appears to have at length discovered that brass and copper are not suitable for use in the connections of secondary batteries, and has adopted lead bars similar to what we have used since 1882.

2. *Rate of Charge and Discharge.*—We may slightly modify Mr. Sellon's own words, and say: "It is not only contrary to fact, but to common sense, to suppose that *his* form, *which consists of thick plates packed with active material*, can be either charged or discharged as rapidly as our thin plates, presenting, as they do, a correspondingly greater extent of surface as compared with weight. The difference in *our* favour, &c."

3. *As to efficiency.*—We are prepared to support the statements already made by us and Monsieur Planté regarding his and the Elwell-Parker cells. As we before said, we have never tested or had any experience of the Electric Power Storage Co.'s cells (when we do we will let them know, so that the cells may be properly treated), so we cannot make any remark upon their efficiency.

4. *Capacity per pound of lead.*—As Mr. Sellon remarks, five ampère-hours per pound are a very modest figure. We have reached this figure even with our heavy stationary cells. We never made any laboratory playthings, never having had any time for play since the demand for a secondary battery sprang up.

5. *Relative durability.*—It is well known that Planté cells have been in constant use for about a quarter of a century, and the recent patents of Planté and Elwell-Parker produce a precisely similar plate in one-tenth the time. We are prepared to point out plates made by us in 1882, which have been in constant use since that time, and are in every way as good as ever, and we challenge anyone to show us a plate, even of the old cylindrical type made by us, mentioned by Mr. Reckenzaun, many thousands of which are in general use, much less one of the later flat plates, which is not still in serviceable condition.

6. We have already replied to this above, and we may add that no *permanent* injury is suffered by the plates when they remain dry and exposed to the air after formation; we only said the plates were rendered temporarily incapable of taking and retaining the charge

The concluding paragraph of Mr. Sellon's letter is beneath our notice, excepting that we are interested to hear that a better and cheaper form of regulator is likely to be produced. Our experience has led us to the conclusion that nothing but a well-formed battery, of extremely low resistance, capable of retaining its charge for any length of time, will act perfectly in regulating the current and giving to the lamps double their average length of life.

In conclusion, we shall be glad to afford every facility in our power for the obtaining of thoroughly reliable data respecting the capacity, efficiency, and durability of the Planté-Elwell-Parker cells as compared with the Faure-Swan-Sellon-Volckmar, and for what purposes each kind is best adapted.

Elwell-Parker, Limited.
Per P. BEDFORD-ELWELL

As you have referred to the correspondence upon secondary batteries, which has lately been carried on in *Engineering*, and may, therefore, in your next issue give "Electrolyte's" last letter to that journal (now signed with the writer's name), I send you a copy of my reply thereto.

I would at the same time wish to remark upon an extract given last week from the *Mechanical World*, in order that I may correct an error into which the writer had fallen, viz., the statement that Mr. Reckenzaun is "my electrician." I have the pleasure of Mr. Reckenzaun's acquaintance, but I have never had the advantage of his services as my electrician.

He is a perfectly independent electrical engineer, who has done very successful work in the special lines to which he has been and is devoting himself.

Although recognising the perfect right of anyone to express his opinion upon my batteries or figures, misstatements of the personal kind alluded to, which naturally cause annoyance and misapprehension of the bearing of the discussion, are to be deprecated.

John S. Sellon.

The Hall, Sydenham,
January 12th, 1885.

[We are glad to see that Mr. Sellon corrects the misstatement in the *Mechanical World* with reference to Mr. Reckenzaun, respecting which we have also received a letter from Mr. Reckenzaun himself, who, however, declines to enter into a discussion of personal matters.—EDS. ELEC. REV.]

Copy of letter to "Engineering."

Sir,—I feel obliged to "Electrolyte" for having dropped his pseudonym and given his case. We may now the better understand one another. I join issue with him at once by stating that Mr. Planté's patent of 1873, which I had never heard of or seen, in *no way governs* my claim for "roughening" plates. Having now obtained and perused the patent in question, I am at a loss to conceive by what possible stretch of the imagination it can be supposed to do so. I certainly have not committed the absurdity of claiming "disintegration" of the plates, if it can be so called, by the electric current. What I do claim, namely, the preparation of the plates, *mechanically, chemically or metallurgically*, so as to bring them into a certain advantageous condition *before* they are subjected to the electric current, bears no analogy whatever to the action above referred to, which is unique in itself and has been well known to every observant electrician since the earliest days of lead batteries. Mr. Maxwell-Lyte, who has, by the way, himself taken out several secondary battery patents, should certainly be amongst those who can discriminate the difference, but for the information of those who cannot, will you allow me to give an explanatory extract from my patent of September 10th, 1881, bearing upon what I *do* claim. This patent was the first taken out by me as the result of original amateur work commenced long before the subject had attracted the great attention which has been subsequently bestowed upon it, and before any other specification upon secondary batteries had been published (except, if it can be so considered, the one of M. Planté of 1873).

Extract, page 3, lines 10—19.—"The plates may be formed of perforated lead or of lead cast with holes either plain or with flutes, corrugations, indentations, shelves or projections in or on to which the material already prepared or to be rendered active can be packed or placed. The plates of lead may also be *roughened on one or both sides* by suitable tools, whether by pressure or striking, or by *any chemical or metallurgical process* giving an equivalent result in such a manner that to a *suitable depth on each side of the plate a spongy* layer or projecting points or surfaces are produced, which are either suitable for retaining the material hereafter to be made active or *for obtaining a more rapid formation of the plates if used without such packing.*"

I venture to say that in so early a stage of secondary battery work it would have been difficult to convey in more distinct and precise terms the description I desired to give.

The words and their meanings are clear and specific. I claim nothing in respect of any *electrical effect* upon the surfaces—*per se*—upon which the whole of Mr. Maxwell Lyte's argument has been built up, but which has nothing to do, as he says, with the gist of the discussion, and I state plainly that until publication or prior work is proved which covers my description, neither Messrs. Elwell, Parker & Co., nor any other persons, are entitled to manufacture and sell batteries made in accordance therewith. In my letter of the 19th December I stated that the Electrical Power Storage Company's patents, Faure, Swan, Sellon, and others, cover the fundamental principles of practical and economical secondary batteries, by which I mean such batteries as will adequately meet the requirements of so-called "storage" upon the extended scale necessary to the rapidly progressive utilisation of electrical energy. The more exhaustive the search into the merits or capabilities of the numerous other existing patents, the more fully will this assertion be confirmed. In Messrs. Elwell and Parker I recognise gentlemen who have with foresight and energy taken up, in a business-like way, a branch of work which I have always maintained to be the key to successful domestic electric lighting, and to a vastly extended utilisation generally of electrical energy. I am sure that it must be their wish to join to their business-like aptitude a fair and equitable consideration for the rights of others, and thus render it possible that the extension of their useful work may be facilitated, and that it may be carried out under justifiable conditions. To recur for a moment to Mr. Maxwell Lyte's reference "as to the gist of the discussion," some of your readers may have forgotten what this is, the correspondence having extended over so long a period. It is not whether Mr. Planté ever "disintegrated" plates by the electric current. It *is* whether Messrs. Elwell and Parker have the right to manufacture plates of certain forms specified by me, by reason of claiming the use of a well-known means for bringing about the condition or form so specified. I would again repeat that the action of dilute nitric acid upon lead, namely, that of "eating into it" by oxidation and dissolution and thus producing a roughened or spongy surface was well known to everyone with any pretentions to chemical and metallurgical knowledge—just as much as was the action of the same or other well known acids upon any of the ordinary metals. Is it to be supposed that anyone could in the same way patent, for instance, the use of strong acetic acid for the same purpose ?

In concluding (I hope, at least, so far as I am concerned) this prolonged correspondence, I would remark that I have never wished or sought to put myself forward, nor do I care one iota whether or not I obtain with the general public any modicum of credit for having worked steadily and consistently in the cause of electrical development with the primary object of the advancement of a most useful and beneficial science, and at considerable personal labour and pecuniary outlay. Certain it is, that in no quarter do I wish for any credit which is not my due ; but I am naturally desirous that the start—*for it is as yet only the start*—of the extended employment of one of the most important appliances for electrical work, should be a fair one, and the rightful position be understood. Great difficulties in this comparatively new line of work have naturally occurred ; one by one they have been, or are being, by perseverance and energy surmounted, and, although there may be much yet to be done, great improvements have already resulted from the experience of the past. There is still an up-hill battle to fight against prejudice, and, I say it with shame, against the antagonism and jealousy of some of those who are interested commercially in electric lighting, and who, instead of giving the encouragement and assistance which might have been looked for, have been apparently only too glad to chronicle and to give undue importance to failures or difficulties which have been incidental, not to any *inherent defect in the principle*, but to inexperience, indifferent workmanship, mismanagement, or bad treatment ; but neither prejudice, nor antagonism, nor jealousy, can prevent the ultimate success of so important an adjunct to the utilisation of electrical energy, and one which, under very many conditions, is as indispensable as it is economical and advantageous.

John S. Sellon.

The Hall, Sydenham,
January 12th, 1885.

Accident to a Dynamo.

A curious accident occurred to a dynamo here which may be of interest to some of your readers.

The dynamo (a Siemens 300 lighter) works to "line" with accumulator in parallel.

For some days it ran very badly, and finally at every hour or so the accumulator discharged through the machine, destroying the safety fuse each time.

The lamps burning at the time were not extinguished, because the fuse was on the dynamo side, so that current was still supplied to the lamp circuit from the cells.

Careful examination was made, but nothing could be found to account for the failures.

Eventually it was discovered that the engine driver had been cleaning the dynamo whilst it was running, and a thread of cotton waste had got wound round the armature spindle in such a way as to get wedged between the collar on the arbor and the bearing, so that every now and then the armature was so retarded by the friction (the belt at these times slipping), that the E.M.F. fell below that of the cells, causing the accidents. It was no easy task to discover the fault, being of a nature not likely to suggest itself, and the piece of cotton waste not being visible.

David Salomons.

Broomhill, Tunbridge Wells,
January 10th 1885.

Heating by Electricity.

I would wish to say with reference to Mr. J. S. Williams's letter dealing with my communication upon heating by electricity that I did not for a moment intend it to be supposed that many others may not have given the subject more elaborate study and have brought far more ability to bear upon it than myself. My object was to draw attention to a development which, I believe, to be of considerable importance, and to be well worth consideration at the present time. I have not in any way claimed, nor could anyone claim, heating by electricity as a principle. What I do claim is simply having devised special forms of apparatus to fulfil certain requirements (combining advantages such as the inlet of fresh heated air and securing ventilation, &c.), which I have successfully employed, and which I believe have not been in any way anticipated. So far as my leisure has permitted—for it is only during my scant leisure that I can give attention to my electrical hobbies—I keep myself posted up in respect of patents issued which bear upon the lines of work of special interest to me. But Mr. Williams will hardly feel surprise if I confess to not having succeeded in reading through the whole of the patent literature issued by him, and I will at once confess that my limited powers of understanding have not enabled me to keep pace with his great ingenuity and marvellous comprehensiveness. I happen to have by me at the moment ten of his specifications for the utilisation of electrical power, extending over a period of about 21 months, from February, 1882. They embrace nearly 200 claims, cover 566 folios, and are illustrated by about 350 figures. Probably this does not represent one-half of the grand total issued by him up to date.

I had not known of the existence of his patent No. 5,233 (which was entered in the name of his agent, Mr. Lake), until mentioned by him in his above referred to letter. I have this evening, for the first time, perused it with much interest, and must congratulate him upon having so clearly foreshadowed the utilisation of electricity in a direction in which I feel sure it is destined to do great things.

I need hardly assure Mr. Williams that I have not the slightest desire to take credit as "first inventor" of any points in which he has anticipated me.

John S. Sellon.

The Hall, Sydenham,
January 12th, 1885.

PATERSON & COOPER,

ELECTRIC LIGHT AND POWER AND TELEPHONE ENGINEERS,

ST. PAUL'S WORKS—76, LITTLE BRITAIN, LONDON, E.C., AND
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Prize Medals, International Electrical Exhibitions, Paris, 1881, London, 1882, and Calcutta, 1883.

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